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The Water Cooling of Glass Tanks

By An Experienced Glass Man

Water cooling of glass tanks has taken many diverse forms. Every conceivable shape of cooler has been suggested and the places where these coolers are to be applied range from the bottom of the tank to the top of the crown.

Water cooled bridges, throats, side walls, bottoms, corners, buck stays, skew backs, jambs, tongues in ports have been urged by manufacturers of these coolers or patented by enthusiastic inventors.

Of all these devices, why is it that we see so few of them in actual use in the glass plants in this country? Is the principle of water cooling wrong or are we stupidly slow in adopting valuable new ideas? To answer these questions it will be necessary to review the experiences of different glass men in the water cooling of their tanks.

At the present time there are two types of water coolers in use. One, the simpler, is to apply water directly to the outside of the tank block where a small leak has occurred or against a piece of sheet iron placed over the block after it has worn thin. The other type is where the water is inclosed in a pipe or small metal box and placed in the bridge or against the outside of the tank blocks at the points where a break is feared.

With the average tank the usual procedure is to start the tank with no water coolers applied except for a couple of pipes (6-inch and 3-inch) through the bridge. When the blocks in the sidewalls or over the throat become thin more water is applied directly to the block or against the sheet iron on the outside of the weak spot. In some factories water boxes are used instead of the sheet iron.

All types of water coolers have certain disadvantages and it is because of these that complete water cooling has fallen into disfavor.

It is an expensive proposition to water cool a tank. If the water boxes are used their initial cost is great if they are purchased from the engineering companies that manufacture them. As they are made of fabricated welded steel plates it is no light matter for a small glass company to decide to purchase enough to them to surround their tanks at all points.

There is the cost of the water to consider and the labor cost of replacing the water boxes at the beginning of each fire.

Since tank blocks are made of unglazed clay they absorb water when it is turned directly on them and in a short time become soft and lose much of their strength. A block that is thoroughly soaked is about as easily cut as wood and any carelessness with tools near a tank block that has softened may result in a hole in the wall. Sometimes the use of high pressure water against a softened tank wall where a small hole has started will make a large hole because the force of the water will break off fragments of the block at the point where the water strikes.

One of the main troubles experienced with water coolers on the walls of a tank is that there is a poor contact between the wall of the cooler and the outside of the block. The air gap acts as an insulator and the block becomes hotter and wears away faster than if the cooler were not present.

Different methods of overcoming this difficulty have been tried and probably the most satisfactory has been to fill the space between the block and the cooler with some grout or like material. Even then the grout when it dries may adhere either to the cooler or to the block and crack away from the other, leaving a space once more than will act as an insulator.

According to the most reliable calculations only 10 to 15 per cent of the heat from the burning of the gas is used to melt the glass. The remainder is accounted for by estimation of the different losses, such as the radiation losses of the furnace, uptakes, offtakes, checker chambers, etc. When one tries to melt glass in a tank completely water cooled, such as an iron shell with double walls having water between the walls or in any tank where a large amount of the glass is directly against the iron it is evident that the water cooler will take more heat from the glass than would be taken by a tank block.

Even though this extra amount should be but 1 per cent of the total heat from the fuel, it may represent 10 per cent of the heat used in the melting and it is taken from the glass where it would have been so used. Consequently there follows a reduction of the melting capacity of the tank and if the pull is maintained at its regular amount, the glass may be seedy or incompletely melted.

If the water used for cooling should contain an undue

amount of the sulphates and carbonates of calcium and magnesium the formation of a harmful scale is almost certain. Due to the difference in solubility of these salts in cold and hot water they will be precipitated in the cooler and become attached to the walls forming a more or less adherent deposit. If sediment or mud from the water settles at the same time a very hard scale results.

When such a scale forms the cooling ability of the apparatus is greatly diminished and the rapid solution of the refractory that is supposed to be cooled follows. The action of the scale as an insulator becomes such that the bulging and eventual burning through of the iron at the spot where the scale is thickest is not unusual.

A source of fairly pure water is as essential for a water cooling system as it is for boiler operation and if such a source is not available a water purification plant may be found necessary. In nearly all the districts where glass is manufactured in quantity the water is badly contaminated with these harmful salts.

If a cooler is improperly designed there is a chance that steam pockets may be formed. When this occurs the efficiency of the installation as a cooler is cut down where these steam pockets are located and it may be but a short time before the iron is burned through at those spots. The exit of the water from the cooler should be at the highest point of the box and the apparatus should be so constructed that a constant circulation of the water is maintained.

When the glass breaks through into the bridge and comes in contact with the waterlog or when the blocks in any part of the tank are eaten away leaving the water cooler exposed there is always the possibility that a break in the cooler will occur that will allow water to find its way into the glass. The same thing often happens when a small stream is directed against a minor break in a block near the glass line.

When the water first finds its way into the tank it is almost immediately volatilized, forming a great number of seeds. Usually these are small and are scattered fairly evenly throughout the glass, especially if the spot where the water is being admitted is well toward the rear of the tank. If the leak is in the bridge the seedy glass may be localized. That is, from the flow holes on one side of the tank the glass may be seedy and on the other side it will be plain and good.

If the quantity of water entering the tank is considerable the glass in that region becomes chilled and stiff, the seeds will be larger and will contain gases that ordinarily would escape from the melting batch. They will be present because the available melting area of the tank will be cut down by the chilled region and the diminution of heat due to its presence. When this happens the water-chilled region may sometimes be seen through the peep hole of the tank and the escape of the steam will be made visible by the rising bubbles which burst after reaching the surface. Eventually such a condition will necessitate the shutting down of the tank.

It is a risky matter to chill a large area on the side of a glass tank with the idea of making the glass inactive by that means. Although the depth to which the chill extends is small, being sometimes but one-fourth inch, it is frequently the case that a small chilled region is the potential source of much trouble.

When glass is held too long at temperatures in the neighborhood of 2,000 deg. F. there is a tendency for the component oxides to separate and crystallize. Ordinarily the glass temperature is dropped through the temperature so rapidly that it does not have time sufficiently long for it to crystallize or devitrify. Its viscosity increases so rapidly as its temperature decreases that the necessary molecular adjustment cannot take place. However, when devitrification takes place in this manner, the crystals are often swept away from the spot where their nuclei formed, either because of a lowered viscosity in the glass surrounding them from a temperature increase or from attrition with the moving glass.

As these crystals are carried out into the glass stream they begin to dissolve and along the path followed by each crystal is a cord which has a composition slightly different from the glass which surrounds it. At times the crystal will not be completely dissolved by the time it reaches the flowhole. In that case it appears in the finished product and is known as "dirty glass."

When large water coolers have been on a tank a sufficiently long time for the refractories to be dissolved, leaving the iron plates directly in contact with the glass, seeds will sometimes appear and no amount of batch changing or furnace manipulation will remove them. In these cases water cannot be found escaping into the glass. It appears that there is a thin layer of stiff glass adhering to the iron and beyond that there is a region that is slightly chilled. In that region the glass is just viscous enough the prevent the seeds from escaping but not so viscous that it is stationary. Being thus at the edge of the moving glass stream the seeds are drawn through the tank and the product is not usable because of their presence.

The water used in coolers often contains acidic matter that will corrode the iron box in which it is contained. The presence of acid in the water or fatty acids in the oil will usually result disastrously. Acidic corrosion is too well known to be dwelt on here.

If air is present in the water it is a recognized cause of corrosion. If this air comes out of solution when the water is in the cooler the oxygen in the air will combine with the iron, forming rust. As this rust is not an adherent scale it will flake off, leaving a pit.

In certain instances galvanic action causes corrosion of the iron.

If the metal containers are made of some of the new non-corrosive alloys the danger from corrosion is lessened. However, such construction would add greatly to the initial cost of the system.

All water coolers become worse than useless when the water supply fails. In many factories where this has occurred it has been but a matter of minutes after the water stopped until the molten glass was in the basement. If adequate protection has not been given to the supporting steel columns, the tank itself and the machines will follow the glass and the wreck will be complete. When it is the water cooler alone that retains the glass, and this is the case when the refractory has gone into solution, the life of the tank is absolutely dependent on the constancy of the flow of the water.

As water coolers are used in some plants there is a continual wastage of the water whose presence is a disadvantage to efficient operation. When water is applied to iron plates

against the tank blocks it is a difficult matter to keep all the water confined to regions where it will do no harm. Even though troughs are placed along the lower edges of the sheet iron, a certain amount of water follows the jack bolts and runs down into the checker chambers and flues where its presence is undesirable. This is also the case where small streams of water are directed at leaks along the glass line. Sometimes a tank will have several small streams playing against its walls involving a considerable loss of water.

Generally speaking, water cooling of the walls of a tank is resorted to as a last resort in order to prolong its life a few weeks. A well known glass man has likened this practice to that of giving a dying man oxygen in an effort to give him a few hours longer to live.

It is the consensus of opinion that water cooling of the bridge wall is a good thing but beyond this few men that have tried the different ways of water cooling will recommend it as standard practice.

The Use of Temperature Gradients in the Fabrication of Blown Glassware

By Roy E. Swain *

The glassworker makes use of a great number of aids in the blowing of his ware, one of the most important of these being temperature gradients. Unlike the foundry metals the fluidity of glass varies with the temperature, in other words, the viscosity increases as the temperature decreases, until a temperature is reached at which glass becomes solid and is no longer workable in the blowing room. Those who have not studied out the whys and wherefores of the different operations employed in producing an article of glass have often concluded that it is necessary to work the glass to a certain shape on the pipe to produce a certain type of article.

In many glass houses one will find pointed blocks that were made with the expectation of dispensing with the slow and tedious operation of marvering and substituting blocking in its place. In making the longer cylindrical shaped articles, it is found that while the piece of glass coming out of the block looks very much like the marvered blank, it has an entirely different character and proves to be unsuited to this class of work.

Perhaps the best way to explain why and how the glass worker uses temperature gradients would be to take up the evolution of some article in each of a few well known types of glass working.

The marvered blank blown in a paste mold is one of the best known American practices, and is usually spoken of as the "American system paste mold." In this system the

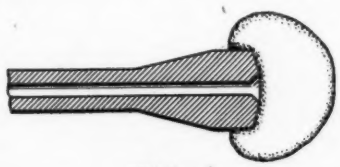


FIG. 1

molten glass is gathered on a clean iron blow pipe, marvered, blown out, elongated or pre-shaped as nearly as possible to the finished article, and blown in a mold. The blowiron is heated but scarcely hot enough to show red, thrust into the molten glass, and slowly turned to wind up a gathering of glass on it as shown in Fig. 1. The pipe immediately begins to absorb the heat of the glass and by the time the gatherer reaches the marver, the glass will have chilled as shown by the shaded section of the sketch. The working on the marvering plate will depend a great deal upon the style of ware being made. If an ordinary narrow neck flask is being made, the gatherer will work the glass "loose," but if a wide mouth

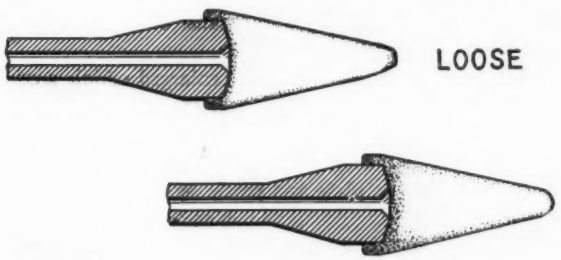


FIG. 2

flask or a flask requiring a heavy neck for stoppers is required the gatherer will work the glass "solid." Loose and solid are only relative terms and the degrees of looseness and solidity are numberless.

Working the glass loose usually means that while marvering very little weight is brought to bear on the pipe and the glass is allowed to play lightly upon the marver as it is gradually brought to a cone shape. Working the glass solid usually means that the pipe is first rolled lightly across the marver to chill the moil. Then pressure is brought to bear on the pipe to force a portion of this chilled glass into the upper portion of the blank. After rolling the blank across the plate several times to chill the surface of the glass next to the blowpipe, the back end of the pipe is raised to quickly form a cone as shown in Fig. 2, the dark sections indicating the colder glass.

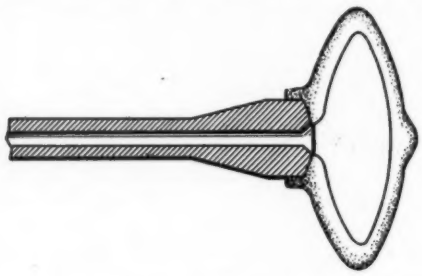
The loose blank when blown out is lively as it is held only by a thin skin of chilled glass. With occasional puffs to extend it this blank is usually allowed to work off the pipe by holding the pipe at a slight angle to the horizontal, the glass being on the lower end. When sufficiently cooled and elongated the blank is placed in the mold and blown. A gentle pressure is all that is required to blow an article of this type. When the glass in the mold has set we have an

* Engineering Dept. Macbeth-Evans Glass Co., Charleroi, Pa.

example of one of the paradoxes of glass blowing, for here the glass that cooled first is hot last and this glass next to the pipe can now be blown very thin and broken to remove the ware from the blowpipe.

The solid gathering of glass is usually worked more after being blown out and swung out to elongate. The chilled glass in the upper part of the blank resists gravity so well that swinging is necessary to hasten the elongation. More pressure is required to blow this type of blank, and the blowing of a bust-off is very difficult and is seldom attempted. The glass is usually cracked off by means of a chisel or

FIG. 3



"wetted off" by touching the glass near the pipe with a wet file.

The two blanks just described were nearly the same shape but of widely different character because of the diffierence in the temperature distribution.

Then there are articles that have enlarged middle sections such as lamp chimneys, double electrics, candle shades, etc., where it is desirable to have approximately the same distribution or wall thickness throughout the article. This is obtained partly on the plate and partly by manipulation after blowing out. Flaring produces a blank similar to the diagram Fig. 3. In this diagram one will notice that the outer rim presents a greater amount of surface to radiate the heat and acquires a set that will give a greater wall thickness to the middle section of the blank. When blown in the mold, it will give the enlarged middle section approximately the same thickness as the end sections.

We have another American system of working a clean iron, known as the wet block. Here, instead of working the glass upon a flat plate, a block or half-mold of round or oval shape is used. This block is partially or wholly covered with water, or a soapy solution. This method of working is best adapted to the production of articles of the same general shape, such as fruit jars, or lantern globes, but is quite satisfactory in making flasks and similar articles of hard glasses. It permits the workman to quickly cover the blank of molten glass with a skin of chilled glass so that he is able to blow the blank out quite large without danger of the sides buckling or collapsing, and get it into the mold with little manipulation of the glass. This method is used when practicable as the production is much larger than that of any other high grade hand method.

There is a limit to the size and weight of the article that can be produced economically on a clean iron. The weight varies with the temperature and nature of the glass. This limitation is due to the difficulty and tediousness of producing temperature gradients sufficient to manipulate the larger amount of glass. Therefore other methods of working have been devised, the best known of which is the German system. There is a modified system that uses the principle of the German system to some extent. This method of working is used in making candy jars and a line of better class containers and consists of first covering the pipe with glass and alowing it to cool and gathering upon this. This first gathering of glass is so chilled and stiffened that it adds body to the blank and permits the workman to handle the glass in such a manner that it can be quickly transferred to the mold and blown. The principle involved will be brought out in describing the evolution of an article made by the German system of glass working.

In the German system a given amount of glass is made to give up its heat in much less time than in the American system and as a result the production is quite high, considering the sizes of the articles made. This system consists of first gathering and blowing a ball, which is allowed to cool, then gathering the body of glass on this ball, and blocking in a wooden or pasted aluminum block to smooth the surface and partially congeal the outer skin of the blank. Sometimes it is necessary to make several gatherings of glass to obtain the amount of glass required.

There are in the German system, as in the American system, an endless number of combinations for securing the desired distribution in all the shapes and sizes of ware that are made, but with an understanding of the principle involved in some of the more important ones, it is possible to work out most of the others, also the variations due to the different temperatures and natures of glasses. However, knowing these principles in no way takes the place of the skill that comes with study and practice, but assists the skilled workman to work out jobs quickly.

Taking a spherical-shaped article, such as a ball globe or a fish globe, as an example, the ball maker will make a ball of approximately the cross section shown in Fig. 4. This is covered by immersing about two thirds to three fourths of the

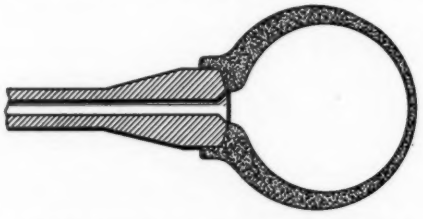


FIG. 4

ball in the bath of molten glass and blocking to produce a blank of the cross section shown in Fig. 5, the dark sections representing the cooler glass with its greater viscosity.

In this system the body of molten glass is supported both inside and out by a layer of partly congealed glass. When blowing pressure is applied that part having the thinner skin with its lesser resistance will extend most in spite of the fact that this is the thicker section and we soon have a spherical shaped article of fairly even distribution with the colder glass near the pipe and the hotter glass in the face.

If the glass near the pipe were not cooler and more viscous, it would be necessary to blow this blank up very slowly in order to allow it to cool to prevent buckling or collapsing. But with the temperature gradient worked into the blank, the blowing up is not only hastened, but the blank is prepared

to resist the elongating influence of gravity when dropped to the mold to be blown.

In blowing flasks or articles having necks, a ball is made similar to Fig. 4, and this is covered by completely immersing in the molten glass. In doing this the complete ball is melted down and can be worked off the pipe to make the neck of the ware. This blank has the characteristics of the loose blank of the American system, already described.

Some workmen prefer working a solid blank and cutting

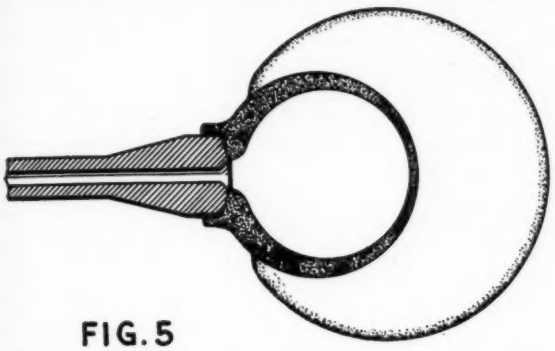


FIG. 5

down to make a neck. This is a more accurate but slower method, and in blowing figured iron mold ware, it makes the use of compressed air necessary to fill out the design sharply.

In the making of very long cylinders great skill is required and the temperature gradient worked into the blank is so great that even those not initiated into the mysteries of glass working could not fail to see it. This blank is formed the same as the one shown in Fig. 5 except that the ball is not blown through so much. After forming the sphere as shown in the sketch, the workman works the solid glass out in front of the ball and into the shape of a cone with a cold knob at the apex. He then proceeds to "warm in" the blank. At first only the point is placed in the fire but as it heats up, the whole blank is worked into the fire. When heated sufficiently the blank is withdrawn from the fire and held almost straight up over head and blown through. It is then given a quick swing to start the elongation, dropped into the mold pit and allowed to run out to nearly the mold's length. The mold is then closed and the article blown.

When the blank is suspended in the pit, each section must support all the glass below it and a temperature gradient must be built up that will give each succeeding upper section the extra resistance to support this extra load without elongating out of proportion to the rest of the blank. Should the workman get the apex of the cone too hot, it will run away causing a light lower section, and should he get the base of the cone too hot the blank will break near the pipe causing a light upper section if it is possible to get into the mold at all.

There are special cases where temperature gradients are used, such as when the blower finds that the blank that he is working has been blown out unevenly. In the case of an iron mold, he can set the light side nearer the side of the mold and equalize the distribution in that way, but the paste mold blower cannot do that, but by idling the glass for a few seconds the lighter side will become chilled so as to resist the blowing air better than the heavier hotter side. As the article is blown the heavier side will stretch more, and the result is a fairly uniform distribution of wall thickness.

By the use of a cooling blast of air, temperature gradients can be set up and the work greatly hastened. When the gatherer or blocker has slighted his work, the blower makes it up by playing a stream of air on the hot section or the section he wishes to set or hold, in order to increase the thickness of the wall in a particular zone. Air cooling has much to recommend it, as it has a fade-out effect and does not cause chill wrinkles such as one finds on ware made from blanks chilled in the block or on the marver, and the increased production is very noticeable.

In making "off hand" lamp chimneys, electric shades, funnels, etc., where the article is open at both ends, the gathering of glass is marvered out to a point and by continued marvering the point is chilled, for by having a greater radiating surface it gives up its heat more quickly than the body of glass. When the body of the article is blown, the knob so holds its heat that it becomes the hottest part of the blank. By cutting down with a pair of tools and giving he knob a sharp rap an opening is made, which after being warmed in is flared out to the desired size and shape to complete this part of the article. A similar knob end is made in making drawn-out stem ware. In that line of ware instead of cutting the knob off, it is drawn out and a foot set on it.

Temperature gradients are usually concealed from the eyes of the layman. By giving the subject a little study and thought he will reach a better understanding of the art of glass working.

Melting Glass by Electricity

The electric conductivity of solid glass mass is not sufficiently high to allow the application of the amount of electric energy necessary to produce smelting without making use of too high and variable voltages. Experiments have proved that most of such materials which might be used for electrodes will contaminate the glass, particularly by coloring it, or will be seriously attacked by the smelted glass. This is the case with common irons and steels and carbon.

The Swedish engineer, G. A. F. Holmgren, has invented a procedure making it practicable to heat the glass materials to fusion by means of electric heating elements forming parts of the walls and bottom of the smelting chamber, in such a way that the glass mass after being smelted will take over part of, or the whole conductance of, the electric current.

Among the materials suitable for making the heating elements are mentioned the following: Certain carbon-free irons, nickel, platinum, iridium, rhodium, certain compounds of silicon and carbon such as silicon-carbide, carborundum, silite, silundum, as well as materials composed of carbon, silicon, and oxygen, for instance siloxicon.—*Abstracted from Industritidningen Norden by Jl. Ind. & Eng. Chemistry.*

"Barium crown" glass for aeroplane camera lenses designed for the previously unheard-of aperature of f/2 and having an exceptionally high refractive index is being produced successfully by British glassmakers, who report that this is the first successful production of a high class telescope objective containing a lense of barium crown glass 15½ inches in diameter.

The Durability of Glasshouse Pots

(A Translation*)

If excessive breakage of glasshouse pots occurs, it is necessary to ascertain the causes of this trouble. They are usually two-fold, namely improper manufacture of the pots or faulty treatment during their use.

The first requirement of a good pot is a proper method of manufacture. A good pot clay must have great refractoriness, great plasticity, small shrinkage and it must be resistant against changes in temperature. There exists no clay which possesses all of these properties. Therefore a good clay can be obtained only by using a mixture of different clays in which each component supplies one of the properties desired. Further details cannot be entered into at this time; it should be remembered that some clays are very refractory and have little plasticity, and others have little resistance against heat and possess great plasticity. From the various kinds of clays a series of mixtures can be made up that are suitable for glasshouse pots for various purposes.

The selection of clays depends on the demands made on the pots. Of great importance is the degree of fatness of the clay. The clay should be neither too fat nor too lean. Pots made from a very fat clay shrink considerably during the drying process and in use. Such a clay cracks easily, and pots made of this kind of clay are very sensitive to sudden changes in temperature. However, the clay should not be too lean, since then there is a lack of plasticity. Using a clay of average plasticity; a mixture of five parts of raw clay to six parts of grog is correct for most purposes.

It is of great importance to know the properties of pot clays. While formerly only raw clay was purchased, and the burning was done at the glass factory, it is now customary to obtain both the raw clay and the burnt clay. This gives a better and more homogeneous product, since the special furnaces at the clay pits deliver a material that is always evenly burned. In the glass factory the burning is usually done in the pot-arches at the same time with the firing of the finished pots. It is easy to see that the temperature and its effect cannot always be sufficiently controlled under these conditions. The raw clay therefore is apt to be insufficiently burned and different mixtures are obtained, resulting in pots having varying properties.

Preparation of the Pot Clay

Raw clay is always delivered in a moist condition, as received from the pit. It is necessary that the clay be dry for the grinding process, to prevent it from balling together, and to render it fit to be put through the sieves. The drying process must not be conducted too quickly, for it has been proved in practice that pots made from quickly dried clay do not have the same resistance against the pressure of the molten glass and break easier than pots made from properly dried material. For the grinding process, the burned or raw clay must be broken up in pieces as large as a fist and must be purified. This is of great importance, in order to obtain the proper kind of pot clay. Every foreign substance which is not resistant against fire causes the formation of holes or cracks during use of the pot. The grain size also plays an important part. The raw clay must be ground fine enough to pass through a sieve having 5 to 6 meshes to the centimeter. Burnt clay, however, should not be ground too finely; it should pass through a sieve of 4 meshes per centimeter. During the grinding process, fine and coarse materials are formed in about equal amounts. The opinion is often expressed that a pot made of clay that is low in fine material will stand up better than one made principally with fine clay. Observation has proved that the former kind breaks up easier in the glass furnace, and is more readily attacked by the molten glass.

Causes of Defects in Pots

If a piece of pot made of fine material is observed, it is found that the coarse particles are loosened from the surrounding materials at one or more places. This is caused by the fact that the raw clay, located immediately around the coarse particle has loosened itself from the same through failure of the burned fine material, resulting in breakage. The refractory material, however, should not consist of too large an amount of fine clay particles, as the strength will then not be sufficiently great. In spite of the greater homogeneity, such pots are apt to crack during the drying and firing processes. Experiments have shown that the capacity to withstand sudden changes in temperature decreases in proportion to the fineness of the clay. The proper conditions are obtained with grains of a definite size, and with an equal quantity of finely ground clay.

When the pot-clay mixture is prepared, the amounts of the different kinds of clay must be carefully measured. The batch must be thoroughly mixed and moistened with warm water in sufficient quantity to obtain a good solution of the raw clay. To obtain a thoroughly homogeneous product it must stand at least three weeks, and must be turned over 6 to 8 times during this period.

The pots are made in different ways. A first requirement is that they must be free from air bubbles. Another requirement for a compact pot material is that the clay must be properly compressed every day, until the mass becomes as tough as leather. Then the real drying period begins. The pot must be covered with dry or wet cloths, according to conditions to promote even drying and prevent too rapid drying. During this time, the pot must be protected from shocks. It should not be removed from its location until the texture has become sufficiently strong that it cannot become loosened by movement. The pots are then transferred to the drying room, where they become completely dry at 30 to 35 degrees centigrade.

Counting from the day of its building up, a pot can be ready for use in six months. The clay house should always be large enough to allow the pots to age until they are about a year old before they are used. It is not until then that certainty exists that they are fully dried. With regard to

* *Keramische Rundschau*, Vol. 34, No. 9, pp. 142-144 (March, 1926).

the durability, it is better that the drying does not proceed too rapidly. During slow drying, the clay mixture can settle better to a compact mass.

If the building of pots is carefully carried out, in the manner described, one can count on obtaining good pots without flaws. Some years ago there were great expectations with regard to pots made by slip casting, since they can be made at a considerably lower cost. However, the use of these pots has remained limited, as they are not as durable as pots made by hand.

Cracks the Most Serious Defect

During use, cracks are formed in the pots, sometimes already during the preliminary firing in the pot-arches, or during transfer to the glass furnace. These cracks are usually at the surface, but the durability of the pot is diminished by their occurrence.

If the pot shows cracks at the bottom edge, the preliminary firing has been uneven. The pot-arch has had too much bottom heat, or the pot has not been completely dry before being put in the pot-arch, or the heating has proceeded too rapidly. If the same kind of cracks do not appear until after one or two melts have been made, the cause may be due to the fact that the pot was not sufficiently white hot during transfer from the pot-arch to the glass furnace. During this time the pot is exposed to the air and cools rapidly. If the pot was not sufficiently hot, the degree of cooling becomes too great, and cracks are formed. These defects also occur if the temperature in the melting furnace is raised too rapidly after the setting of the pot.

In the process of pot-arch firing, there are two sharply divided periods, the drying period and the burning period. The latter operation can proceed at once if the pot is properly dried. If however traces of moisture remain in the clay, the pot must be dried slowly by a small fire. The draft must be regulated in such a way that the gases and vapors are completely removed. Water vapor should not be allowed to condense on the walls of the pot, as this would cause them to become soft. The draft should not be too strong, as this would cause cold air to be drawn into the opening of the pot-arch with the result that the pot nearest to the opening will be hit by the inrushing cold air, and become chilled locally. This causes great internal strains.

The preliminary drying must go on, as long as water vapor is formed. If the burning begins at once, the water present in the clay does not evaporate, but forms steam. The steam through its expansion shatters the texture of the pot; often a large part of the wall or the bottom is loosened. During the burning process, the temperature must be raised gradually through a slow increase of the firing and the draft. Care is needed especially during the period of red heat.

The pot-arch must be built so that the fire enters in front, runs under the bottom of the furnace and passes into the pot-arch through a flue, which reaches a few centimeters above the pot. In this way there exists an even heat in the upper and lower part of the furnace and local overheating is excluded. To avoid too much bottom heat and uneven heating of the bottom of the pot and the walls, the flue under the bottom of the pot-arch is covered with fire clay slabs of 10 to 12 centimeters in thickness. The longer and the sharper the pots are fired in the pot-arch the greater their durability.

At the time of pot setting, the melting furnace should not be too hot. If a number of pots are set, the furnace should have about the same temperature as the pot-arch. If only a few pots are set, the temperature should be allowed to decrease to such a degree as is possible without endangering the pots already in the furnace. During the setting, the air and draft holes must be closed, so that no sharp flames shall be present, and to prevent the cold air from entering. After the setting of the pots, the draft can be increased somewhat. The furnace must then be kept well heated. After two hours the draft is increased again a little and after two hours more a little preheated air is admitted. Every two hours the fire is increased somewhat.

Another kind of cracks are those which occur near the top of the pot. These are usually due to excessive heat in the pot-arch, and are apt to occur when there is no flue, and when the heating takes place through the sides. Or the firing takes place at the end of the flue, and there is no fire under the bottom of the pot-arch. This kind of crack also occurs if the flue does not reach above the pot walls, so that the flame strikes the pot directly. Cracks may occur during transfer from the pot-arch to the melting furnace, when the pot is grasped with cold tongs. They may further be caused by excessive draft in the furnace, which draws cold air through the working holes and cools the pot too much.

Another defect shows itself when a straight crack occurs directly above the bottom, on the inside of the pot. The cause of this trouble is due to uneven heating in the pot-arch. If the firing has been too sharp or if too much heat has been applied to the bottom it may become overheated, with regard to the walls immediately above the bottom. This defect may also occur in the melting furnace if the newly set pot is heated too rapidly, or if the heat is applied locally.

The most frequent defect is cracks running in horizontal or vertical directions occurring on the inside or outside of the pot. The outside cracks occur when cold air strikes the pot during the heating in the pot-arch, or if the pot is exposed to a strong draft during transfer from the pot-arch to the melting furnace. In the furnace these cracks occur when the pot is exposed to excessive draft which causes an inrush of cold air through the openings in the furnace walls.

During the use of the pot cracks may occur on the side of the fire, in horizontal and vertical directions. Usually these cracks do not penetrate far into the walls and they fuse together without damage to the pot. They are caused by sharp flames, which locally overheat the walls of the pot.

The durability of the pot is considerably more affected by inside cracks, than by those which occur on the outside. If they are present, they are due to uneven and too rapid heating in the pot-arch, especially during the period of change at red heat. Pots cool rapidly on the outside but remain hot inside. This causes strains, resulting in rupture of the pot material. Very often it can be observed that cracks appear immediately after the first melt, or after a few days or weeks. They are usually due to rapid cooling during the setting of the pot.

When making the first melt, the pot must be thoroughly heated at the time of the first filling. At least two hours before filling, the bottom should be glazed carefully. To accomplish this, several shovelfuls of cullet are introduced.

The cullet is first exposed to the furnace heat for some time.

How difficult it sometimes is to recognize the causes of the formation of cracks in pots, while in use, may be seen from the following example. In a glass factory the pots showed cracks in the middle part of the walls, after being in use for about one to two weeks. These cracks formed on the inside, and on the part turned to the fire. They became wider and longer with each melt, so that the pots were useless after four or five weeks. A twelve-pot furnace was used, and white, colored and opal glass was made. The white and the colored glass batches were always filled in the pots after working hours of the glass blowers, at a time when the pots were not completely heated. The defects always occurred in these pots. Those used for opal glass, which were filled two hours later, did not show any cracks. Although it was apparent that the cracks were due to the fact that the pot was too cold when filled, yet the blame was put on the pot material. It was claimed that the cracks were due to moisture, and that the defect therefore had its origin in the clay house. Although this cause of the defect was not impossible, the trouble should have shown itself, if not already in the pot-arch, then certainly after the second melting. Furthermore, the cracks could not be due to moisture, since they should also have occurred in the opal glass pots. As is well known, opal glass attacks the pot more severely than white glass. The opinion was expressed that the cold filling could not be the cause of the defect but that on the contrary the trouble would be more serious if the pots were heated to a high temperature. It was believed that a very hot pot would suffer more when filled with the cold batch. This supposition is not without foundation; however, practical experience is to the contrary. It has been shown that the clay material of a pot at white heat is not as sensitive to sudden changes in temperature as at a dull red heat. This can be explained as follows: If a white-hot pot is filled, it is cooled down to a red heat. The batch next to the pot walls becomes very hot, due to the great heat, so that a considerable amount of cooling of the walls does not take place. The case is different if a moderately hot pot is filled. Then the cooling caused by the cold batch is so great that the walls do not remain glowing, but become dark. This causes great strains, which result in cracks. Not until this was understood, and the furnace was sufficiently heated before the filling of the batch, did the defect disappear.

Longitudinal cracks are caused by overheating of the batch, or by excessive pressure during "blowing." In both cases the cracks usually pass immediately through the walls and the pot breaks completely. Overheating of the pots has the same consequences, for the pots are only solid enough up to a certain temperature to withstand the pressure of the molten glass.

Especial attention must be given during the fining period. As soon as all the batch materials are dissolved, the heat consumption due to melting stops, and to prevent overheating, the furnace must be cooled systematically. Even greater care must be exercised when the glass becomes clear. The glass mass gradually settles, and exerts its full pressure on the pot walls. If the heat is too great, the soft walls cannot stand the pressure and burst.

The destruction of pots through corrosion is especially marked in the case of lead and opal glasses, above all with opal glass, used for casing. The fluorine salts settle on the bottom and attack the pot so that holes are soon made in the bottom. Precautions against this trouble are only partly effective. By keeping the glass mass in constant motion by frequent "blowing," the fluorine compounds are prevented from settling on the bottom. Sometimes a series of holes occur. This trouble, when it occurs on the inside of the pot walls may be due to an excess of saltpetre, or other material which dissolves the clay. It is also possible that the clay used to make the pot contains substances that are easily melted, or inferior clay has been mixed with the pot clay. If corrosion occurs on the outside, it is an indication that too sharp a flame is being used.

Zinc Oxide and "Seeds" in Borosilicate Crown Glass

Borosilicate crown glass is employed quite extensively for making the reflecting prisms used in optical instruments, such as range finders and periscopes, and it is also becoming popular for lenses and optical windows, and flats on which graduations or scales are ruled.

For some of these purposes the glass must have an index of refraction of approximately 1.517, and it must be absolutely free from even small bubbles or "seeds," as they are called. At times considerable difficulty is experienced in obtaining glass of the desired quality and in satisfactory quantities.

This kind of glass, free from seeds, has been made repeatedly in the Bureau of Standards' experimental glass plant, says the *Technical News Bulletin,* but the index of refraction is somewhat higher (1.520 to 1.523) than desired (1.517). In an effort to obtain a glass with the desired index of refraction the zinc oxide was eliminated from the batch, and although this gave the desired refractive index the glass was almost invariably "seedy." Although numerous changes were made in the temperature of the melting furnace, the length of time allowed for melting and fining, and the method of stirring, it was apparently impossible to make a "seedless" glass. As soon, however, as about 2 per cent of zinc oxide was added to the batch the seeds disappeared, but the refractive index increased.

From this it seems that a reduction of the index of refraction by eliminating zinc oxide can only be made at the expense of the quality of the glass. The bureau's next step will be to reduce the quantity of barium oxide to see if this change will give both the desired quality and optical constants.

The following table gives the index of refraction (N_d), dispersion (V), and the ratios between the percentages of silica, barium oxide, and zinc oxide (the alkalies and boric oxide being practically constant) of four borosilicate crown glasses, the first of which contains no seeds, the others being practically useless because they were too "seedy."

Glass No.	N_d	V	SiO_2:BaO:ZnO
1	1.5230	63.5	1:0.040:0.040
2	1.5186	64.1	1: .041: .016
3	1.5169	64.6	1: .040: [1].004
4	1.5176	64.7	1: .037: [1].011

[1] The zinc oxide indicated was derived from the "cullet" used in starting the melt.

The Story of Engraved Glass

Abstracted from "The Story of Engraved Glass" by Gardner Teall in September Issue of "House & Garden"

A Spanish example of cut and engraved glass of the 18th Century. From the Riano Collection in the Victoria and Albert Museum

WHEN the exhibition of Les Arts Décoratifs was held in Paris in 1925, visitors were greatly impressed by the many exquisite examples of engraved glass displayed. These particular exhibits, coming from many countries, brought the art-loving world to a realization of the fact that we have entered upon a renaissance of the craft of engraving glass.

The new interest in this beautiful art sends us back to a study of its history and of those who wrought these beautiful objects with such consummate skill.

The Portland vase is, I suppose, almost as familiar to most persons as the Venus de Milo or the Dying Gladiator. After the tragic disaster which befell it (caused by a madman who dashed it to fragments on the floor of the British Museum where it was exhibited) and its subsequent restoration, this incomparable relic of antiquity became more famous than ever. Fortunately the piecing together of the fragments was made possible by the existence of exact copies of the vase which, some time before, Josiah Wedgwood had manufactured at his pottery works. As these remarkably fine reproductions in Wedgwood-ware are still to be found, and ever currently produced from the Wedgwood moulds, there are many who labor under the mistaken impression that the original Portland vase was of ceramic fabric instead of being glass, cut cameo, as it is. Antiquity has scarcely handed down to us a more beautiful relic.

Engraved glass appears to have been the latest development in the artistic history of this material, even though it goes back so many centuries. Glyptic art naturally suggested to the ancients the cutting of stratified glass in a manner to simulate cameos of semi-precious stones. But even in ancient times such work could not have been common. One may believe the Portland vase, in the first century A. D., was as highly esteemed and considered fully as precious as it is by our own generation.

The artists in glass of the late centuries were probably inspired by such examples of the glyptic art as they found in the earlier engraved crystal objects. Indeed the Italian glyptic artists of the Cinque Cento produced engraved crystal pieces of great beauty. One of these crystal workers was Valerio Belli, called Vincentino (1479-1546). Among other early Italian crystal engravers were Girolamo and Caspare Miscroni, of Milan, who received commissions for their craft from the Emperor Rudolph II.

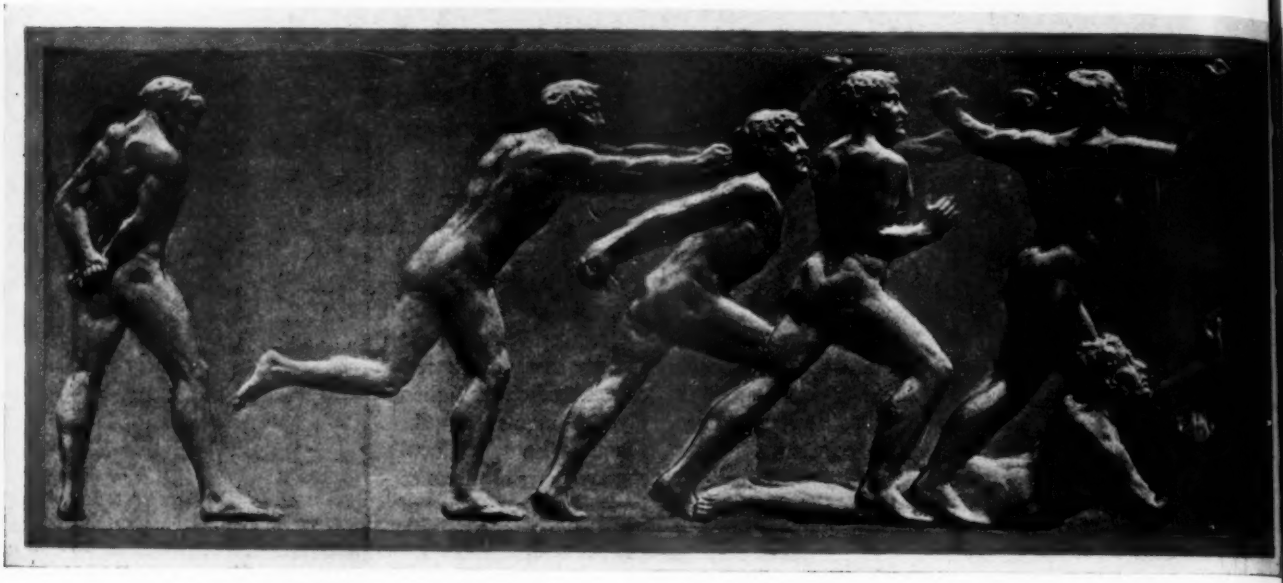
The base of the Portland vase, the most beautiful example extant of Roman engraved glass, cut cameo. Shattered by a madman, but cleverly restored. From the British Museum.

Either from England or Ireland came this wine glass engraved with William III crossing the River Boyne. 18th Century.

The soverigns of the 16th Century in the north countries had an eye to things artistic, and crystal cups fashioned by the deft hands of Italian artist-craftsmen particularly appealed to them. Likewise, it came to be with beautiful objects in glass, for these same lords were not content with relying on the importation of art objects; they definitely gave continued encouragement to home production, and their own artists did not lack in substantial patronage or the means of bringing their products to perfection.

Writing in 1675, Sandrart, an early authority on glass, says that the art of cutting (engraving) glass was rediscovered by a German named Caspar Lehmann "Privy Gem-engraver and Glass-cutter to the Emperor." A patent of protection and "twenty marks in gold, fine alloy," were his reward. Lehmann did much to perfect the processes of glass-engraving. He died in 1622, but left a pupil and worthy successor, George Schwanhart, and under him the art of glass-engraving advanced with such strides as to win him praise on every hand, and his character was such as to bring to him the friendship of the most important people at court.

Sandrart refers to the somewhat clumsy apparatus which the early German glass-engravers employed. "When we consider the big heavy wheels that they were fain to employ, turned by those flourishing weeds—their loutish



The greatest contemporary French master of engraved glass is Renée Lalique, whose work is highly prized by collectors. This is part of a Lalique panel, and has the action and vigor of a Parthenon frieze.

assistants—we may well marvel at the work they turned out. . . . And yet these glass-cutters of today, with all their advantages, might obtain from the patrons still greater praise were they to devote themselves more to the practice of drawing and to traveling about, instead of marrying early and, as a consequence, having to work in the kitchen."

The Venetians had engraved glass by the diamond-scratching method. The Germans also used this method before (and also after) Lehmann's wheel-engraving method. In Silesia engraving glass with the diamond point reached great perfection in the 16th Century. But the first to "engrave" glass by means of acid appears to have been Henry Schwanhart, a brother of the George Schwanhart, mentioned above. He produced pieces engraved with landscapes, views of cities and quite elaborate work. One shows a fine and correct view of the city of Nuremberg.

A panel of engraved glass of early workmanship. The source is Germany. It is dated 1620

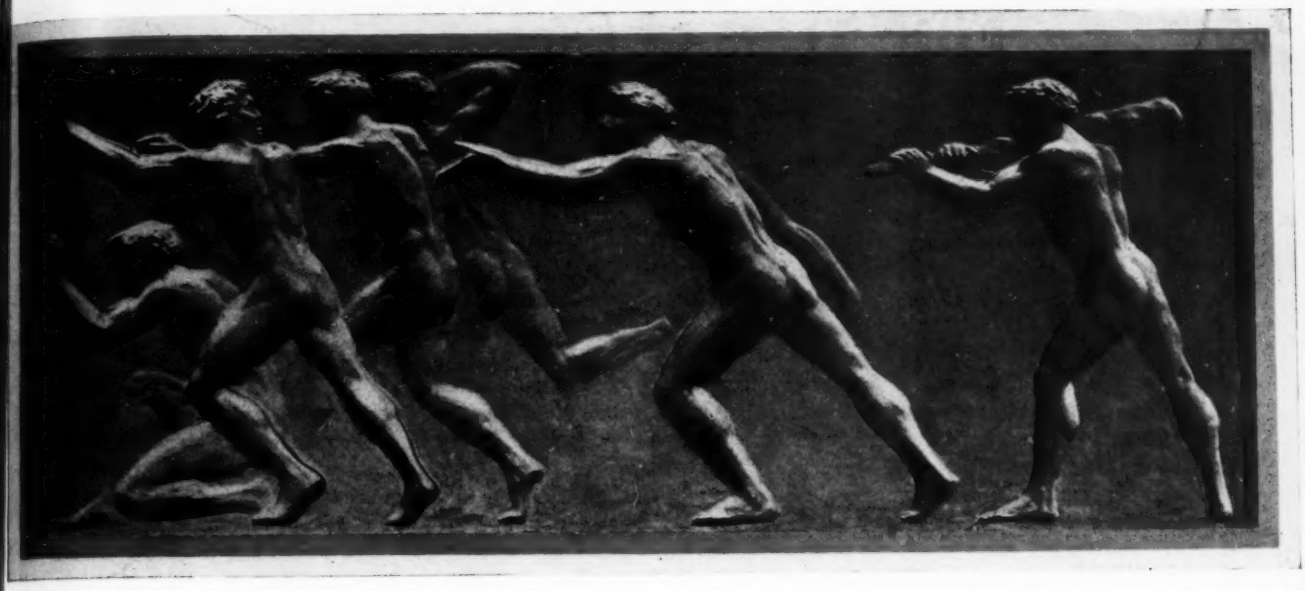
We may consider that glass-engraving comes under five general heads: engraving by scratching with a diamond; engraving by means of a small revolving wheel; engraving with a cutting wheel aided by emery powder or like material; by means of a large wheel (as used in the production of what we call "cut glass"); engraving by exposing surfaces to the fumes of hydrofluoric acid, the only acid that will attack glass.

The *Pointillé* (Stipple-dot) method of glass engraving came greatly into vogue in Holland in the 18th Century. Wolf, who worked at The Hague, was its greatest master.

The coming to London of Jacob Verzelini and other Venetian glassworkers in the 16th Century naturalized the glassworkers craft in England. This culminated in the discovery of flint glass by George Ravenscroft about the year 1677.

The French artist Emile Gallé born at Nancy, 1846, revived an interest in glass by his remarkable productions, cut and engraved with extraordinary skill. He sought all sorts of effects in colored and in plain glass and their combinations. Some of the best of the Gallé glass is wonderful and beautiful. Perhaps all of it is wonderful, although not all of it is beautiful. Gallé was truly a poet whose poetry was written in glass. In the Musée des Arts et Métiers, Paris, is a memorial collection of Gallé glass which everyone interested in the history of glass should endeavor to visit.

The next great French glass engraver is our contemporary, Renée Lalique, an artist in every sense of the word. He, too, is a poet in glass, and gives us in his work a unique interpretation of Nature.



Another Lalique panel, companioning the one shown opposite, is distinguished for the fine modeling of the human figures and the spirited action in their composition that approaches the Greek

England of the 18th Century created with glass. This cordial glass is engraved with a rose and buds, a withered tree and the inscription, Reverscit

In the group below are two goblets and a wine glass, all engraved with Jacobite emblems, and dating from 18th Century England. One of the goblets is engraved with a portrait of Prince Charles Edward Stuart. From the Schrieber Collection

An 18th Century Spanish example of engraved glass in which a chateau and trees figure. It has an interesting winged handle ending in a decorative shell

Fifty Years of Glass-Making

By Alexander Silverman*

During the half-century that has elapsed since the founding of the American Chemical Society many new industries have had their birth. Glass-making, one of the oldest of the arts, probably had its origin in Egypt over 3500 years ago, and was the first industrial enterprise in the American Colonies, with a factory near Jamestown, in the Colony of Virginia, in 1607. Nevertheless, developments made in this field during the past fifty years eclipse everything that preceded. Even the application of art in glass manufacture and treatment has possibilities today which equal those of old, and excel, because larger scale production enables more of us to possess the product.

Outstanding among the developments are modern window, plate, bottle, and hollow-ware manufacture, tube drawing, chemical and optical glass making. Inseparably coupled with many of these developments is the evolution of fuel, and furnace design and practice.

Window Glass

We are told that Theophilus, an Anglo-Saxon monk of the twelfth century, blew the first window-glass cylinder, cracking and flattening his cylindrical bubble, as is still done in the Belgian or hand process, except that the procedure was crude. Robinet, a Frenchman, used an air pump for blowing glass in 1824, and already in 1854 Loup, another Frenchman, resorted to the bait and compressed air for drawing window-glass cylinders. Real success did not come, however, until 1903 and after, when the Lubbers machine was invented. This, with many mechanical improvements which have been patented from time to time, is the machine which produces most of our cylinder glass today. In principle it is the Loup idea, an iron bait dipping into molten glass, compressed air blowing the initial bubble, and air under lower pressure preventing collapse of the cylinder while it is being drawn.

A subsequent and novel modification by Frink should be mentioned. In this the bait is a metal cylinder of substantially the same diameter as that of the glass cylinder, and air at constant pressure is introduced through a raised opening in the middle of the crucible which contains the molten glass.

Loup drew his cylinder right out of the pot in which the glass was melted. In 1872 regenerative tank furnaces had already replaced some of the regenerative pot furnaces invented by Siemens and first used in Germany in 1861. These tank furnaces were a boon to window-glass manufacture, for it was only necessary to ladle the constantly forming glass into shallow crucibles, lower the bait, and blow and draw the cylinders. Then came the reversible double crucible, whose under side was exposed to flame for melting adhering glass away while the upper half contained molten glass which fed the glass cylinder. Of course, there were accessory inventions such as supports for lowering the huge cylinders, electrically heated bars and nichrome wires for cracking, rotating ovens for flattening, and continuous lehrs for annealing. The muffle lehr, where radiated heat insures greater uniformity than direct firing, is gradually gaining precedence, and when electricity is sufficiently cheap electrically heated lehrs will undoubtedly take the lead because of facility of control.

The slitting and flattening of cylinders seemed wasteful of time, and it was long the ambition of inventors to produce sheet glass directly. Two successful processes have resulted, the first invented by Emile Fourcault in Belgium, the second by our fellow-countryman, Irving W. Colburn. Fourcault secured his first patent in 1902; Colburn in 1903. They are entirely different in principle and operation. That the window-glass world has taken serious note of the importance of direct and continuous sheet production is evident from the number of patents issued weekly for processes or their improvement.

The Fourcault process depends on glass rising through a slot in a fire-clay float, subsequently being carried upwards between rolls. The annealing is done in vertical lehrs as the sheet rises. In the Colburn process the glass adheres to a straight metal float rod or bar, which is carried upwards and then over rolls in a horizontal direction. Flames play on the sheet where it changes its direction from vertical to horizontal. A single Colburn machine is said to produce more glass than forty men formerly blew by the hand method.

Wire glass is now manufactured by leading the wire between two sheets of glass. This has the advantage that, although it may crack, the glass does not shatter and fly.

From what has been said, one is apt to think that all of the contributions to window-glass manufacture have been made by the engineer. Cylinder and sheet glass machines are worthless without physical and chemical control. Temperature control and uniform rate of draw are essential. The viscosity of the product must be constant. The glass must be clear and not have a tendency to devitrify. It must be free from seeds or gas bubbles. It shall not contain stones from the refractory lining of the furnace. It must be without cords or striae. The surface shall be bright when the sheet leaves the factory and must stay bright. These exacting requirements can only be met by careful physical and chemical control, and the fact that this is still seriously neglected in some plants is seen in the manufacturing losses and quality of product. A machine is no better than its product. If the machine is inflexible, the glass must be uniform in composition and worked under proper control.

Plate Glass

When Lucas de Nehou first rolled plate glass at Saint Gobain in 1688, he little dreamed of the vast production of an "automobile age." The French process was substantially that of the present day, consisting of pouring the glass on the casting table, rolling, annealing, grinding, and polishing. Plate-glass manufacture began a profitable career at Creigh-

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From *Industrial and Engineering Chemistry*, September, 1926.

ton, Pa., in 1881. Although the melting furnaces have improved and mechanical methods have largely replaced labor it is only a few years since glass has been run from continuous tank furnaces, onto casting tables, through lehrs, and to the grinders and polishers, in one continuous process. This is virtually a third continuous sheet process, and differs from window-glass manufacture in that the glass is rolled instead of drawn.

In plate glass, as in window glass, wire may be introduced, but here a single plate is rolled, wire laid on, and then more glass poured and rolled over the wire. In the new continuous process the principle of running wire between plates may apply as in window-glass manufacture.

Bullet-proof glass is another plate product. Here two or more plates of glass are cemented together under pressure by a transparent plastic material. This is of service in banks and armored cars.

The manufacturer of plate and window glass is getting some competition from manufacturers of thick panes of a celluloid nature. So far most of these lack sufficient transparency, freedom from color, and permanent surface polish. However, progress towards perfection is fairly rapid.

Plate glass, like window glass, has improved through studies of chemical composition and its effect on appearance and mechanical properties. However, in a rolling process less careful control is necessary than in the drawing of sheet.

Bottles

Bottles were blown by hand in Egypt in ancient times, and have long been made in molds, but it was not until 1882 that a bottle was pressed in a mold, including the finished neck. Numerous improvements followed this accomplishment of Arbogast. Today we see the Owens bottle machine, invented in 1903, subsequently improved, and perhaps the best example of the many mechanical devices in this branch of glass manufacture. It will produce a finished article anywhere from a one-drachm tube-vial to a demijohn.

Electric Bulbs

Electric-lamp bulbs were formerly blown by hand from lead glass. Today over a million bulbs are manufactured daily in the United States by machine, and from lime glass. Blue glass, to provide light like the northern sky at noon, is used in the so-called daylight lamp, now largely employed in matching booths, and industrial lighting.

The latest development in bulbs for general lighting is the inside-frosted bulb. This required extensive research for its perfection. At first the bulb was subjected to a single etching and crushed like an eggshell under the vacuum. Later it was found that a second or even third wash with etching solution of a different composition would tone down the rough cracks and strengthen the glass. These bulbs are rapidly displacing the older types, and possess the advantages of external cleanliness and higher light transmission.

X-ray bulbs, requiring glass of such a composition as to permit the generation and passage of the penetrating rays, are another product of the last half-century. With these came glass shields to absorb the rays and protect the operator.

The radio industry with its many special types of tubes has again required research. Glass had to be produced that would serve for the various sealed-in tubes, rods, and metal parts, without crystallizing or "devitrifying," as the glassmaker would say.

In the manufacture of lamps enormous quantities of glass tubing and rod are employed. Machines now make both continuously.

Then there is fused quartz, opaque to transparent, which enters into the manufacture of mercury and other vapor lamps to provide ultra-violet light. As early as 1839 Gaudin prepared fiber and shot of fused quartz, but it was not until recently that Elihu Thomson and his associates prepared a product of great transparency and purity in a specially designed vacuum-pressure electric furnace. This quartz has promise for surgical lighting instruments, optical devices, and window panes for admitting ultra-violet light. To be sure, one must not overlook the properties of glass substitutes of organic origin for the last-named purpose, as the "urea-formaldehyde" sheet and products of older methods also transmit ultra-violet light.

Lighting and Table Ware

The tendency in lighting has been to direct the light flux, through illumination studies and design, and to increase or decrease light transmission for efficiency or art's sake, according to the ideas of the designer. When carbon lamps were employed, alabaster glasses were desirable, as opal glasses transmitted too yellow a light. With the advent of the tungsten lamp, especially the concentrated-filament type, glare had to be eliminated without impairing transmission. Studies on high zinc oxide-alumina borosilicate opals have given us a new type of glass for intense light sources.

Signal lights have been the subject of much study and their colors are now largely standardized.

Among the new coloring agents that have played a leading role during the fifty years is selenium. It is not only used in signal lenses, but has entered society in the amber, orange, ruby, and pink glasses which have been so popular for table ware. Selenium has also largely displaced manganese dioxide as a decolorizer for correcting the green color in glass which is due to iron compounds in the raw materials, while neodymium oxide accomplishes the same purpose in borosilicate glasses. The fluorescent greenish canary of uranium glass and golden yellow of cadmium sulfide have also been popular. There are really few new coloring agents.

Treatment and Decoration

The inside frosting of bulbs has been mentioned elsewhere in this article. Acid polishing is another interesting development applied in the manufacture of cut glass. Lead glass is ground, but instead of being polished with rouge is dipped into a mixture of concentrated hydrofluoric and sulfuric acids. A gelatinous scum forms, which on being brushed off leaves a bright surface.

The air gun is used to apply decorative colors and metallized coats to glass. The silvering processes of Petitjean and Liebig have been improved and are now backed electrolytically with copper instead of paint.

(*To be continued*)

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The Future of Oil for the Glass Industry

The controversy regarding the future of our oil supply is one of serious concern to glass manufacturers, especially those who have installed fuel oil equipment, or who are considering the purchase of such installations to take the place of a dwindling supply of natural gas.

The Federal Oil Conservation Board, consisting of Secretaries Work, Hoover, Wilbur and Davis asserts that the future maintenance of the oil supply depends on constant discovery of new fields, improved methods of recovery, better control of production, greater economy of consumption and additional supply of oil by distillation of shales and coal. The report contains the startling information that there is only a six years' supply of oil in sight, if present methods of production and consumption are maintained.

Coincident with the issue of this report, the production of crude oil, while still below the highest total on record, made rapid strides during the month of September towards the highest daily average production, recorded in 1925.

While the Conservation Board gives warning that a condition exists which in a few years will seriously impair the industrial situation, oil producers, well qualified to judge, insist that there will be no scarcity of oil for years to come. At the meeting of the American Chemical Society in Philadelphia it was emphasized that the chemical industry is prepared to supply synthetic substitutes for present sources of supply. This expression of optimism did not fail to bring a retort by government scientists, pointing out that all synthesis to be practicable must have as its basis a natural resource available in large quantities and at a low cost.

With such a complete diversity of opinion between experts on either side of the question, the task for the manufacturer, confronted with the making of a decision, between oil and coal gas is difficult. Future prices rather than present cost should be the basis upon which to make an investment for equipment. The preponderance of evidence appears to be in favor of coal as a source of heat. Whatever may be the oil supply of the future it is highly probable that the burning of fuel oil, as now practised, will become restricted by high prices or even by law.

More automobiles are in use for business and pleasure than at any time, and the capacity of the country to absorb an ever increasing supply of motor cars appears to be unlimited. Considerable freight and passenger transportation is being diverted to motor trucks and buses, internal combustion motors are being used in navigation. The anthracite coal strike has given increased impetus to the sale of fuel oil for domestic heating. All these uses are at the expense of the supply of oil available for industrial purposes. Will it be possible for the glass industry, with its enormous requirements of heat in proportion to the value of its products, to pay the price? No one is able at the present time to decide. But as conditions stand, the conservative and safe policy points towards dependence on coal rather than oil for the glass industry.

The British Navy, is the largest user of high-grade optical glass and instruments in the world, and in its contracts the Admiralty now specifies, as it did not before the war, that its optical stores shall be throughout of British manufacture.

Technical Consultation Service

Selenium vs. Sodium Selenite

QUESTION 101.—I understand that sodium selenite can be used instead of selenium as a decolorizer and that by using it the large losses of selenium due to its volatility are avoided. If this is the case, why is it that many glass manufacturers refuse to use sodium selenite.

ANSWER. Sodium selenite (Na_2SeO_3) contains 45.7 per cent selenium. Therefore, it is necessary to use 2.2 as much of the selenite as of the metallic selenium to introduce the same quantity. This should be taken into account in comparing prices.

Sodium selenite is just as good, or according to some, even better than selenium. However, most glass makers are now used to selenium and it will take some persuasion to have them change. To those who are not chemists, it is not at all evident that the salt of selenium is just as effective as the element, provided the proportionate amount is added.

The price of sodium selenite must be made attractive for otherwise many glass makers, who are satisfied with selenium are not going to change over to the salt. It must be entirely free from iron and copper. Selenium sometimes contains a small amount of copper, which of course makes it worthless.

Everything that is said in technical articles about selenium also applies to sodium selenite, with the provision that 2.2 times as much must be used of the latter.—J. B. K.

Bureau of Standards Reviews Year's Work

The work done and results accomplished by the Bureau of Standards in the ceramic field since the summer of 1925 have been reviewed by the Bureau in a report recently issued. Glass, pottery and fine ceramics, enamels for metals, heavy clay products and miscellaneous subjects are covered. The following abstracts are from the report.

A study of the composition and physical properties of special glasses was included. The purpose of the work done on this subject was to study the factors which affect the quality of optical glass during melting, molding and annealing. Among these may be mentioned the time and temperature required for melting, the reduction or elimination of seeds and striæ and control of the index of refraction.

In addition work is being done to determine the relations between chemical composition and physical properties of glasses on a scientific basis and to obviate the necessity of using the numerous conflicting empirical data that are now available.

A total of 36 pots of optical glass were melted. The composition of the batch for the last nine melts was modified by adding about 2 per cent of zinc oxide.

These glasses were melted according to previous schedules and were much more satisfactory than similar glasses containing no zinc oxide. Zinc oxide was previously used in making borosilicate glass whose index of refraction was 1.520, but was gradually reduced in quantity and finally eliminated entirely to give a glass of the desired index (1.517). It now seems that the index of refraction might better be reduced by a reduction in the content of barium oxide.

A Non-Actinic, Cobalt-Blue Glass

Three glasses were made to determine if a glass containing pure cerium oxide absorbs the ultra-violet rays or whether the ultra-violet absorption usually attributed to cerium might be due to some of the other rare earths which frequently accompany it, and then to see if cobalt could be added to the cerium glass to produce a cobalt-blue glass which would have both the desired color and ultra-violet absorption.

Glasses of three different compositions were made. They melted and fined readily at 1,425 deg. C. and worked easily. The apparent color of the cerium-cobalt glass was so similar to that of the ordinary cobalt glass that it was practically impossible to differentiate between them by visual inspection.

The ultra-violet transmission, however, was markedly different, No. 11 having a much higher transmission percentage than the others. This glass contained no cerium oxide but had the same amount of SiO_2 and Na_2O, more than double the quantity of CaO contained in the other two batches, and 0.1 per cent CoO.

A non-actinic, cobalt-blue glass will have a practical application because safety engineers have insisted that men working around open-hearth or other high-temperature furnaces use a brown glass which reduces the intensity of the light from the furnace and also offers good protection against the ultra-violet rays. However, the furnace operators themselves prefer a blue glass regardless of the fact that it only gives partial protection against the ultra-violet rays, maintaining that they can observe furnace conditions better through a blue than through a brown glass. This prejudice is probably due to their greater experience with a blue glass, because brown glasses are now being extensively used with satisfactory results in some industries.

The blue glass recently made at the Bureau has, in addition to the color and other desirable properties of the ordinary blue glass, the very desirable property of furnishing protection against the ultra-violet rays.

Chemical Composition and Physical Properties

Computations on the relations between chemical composition, density and index of refraction have been continued, with a view to obtaining a series of constants for the constituents of soda-lime glasses in the ordinary range of commercial compositions and to determine, also, if possible, the relation between density and index of refraction.

A very satisfactory series of density constants has been obtained which differs from those previously suggested by Schott, Turner, Tillotson and Baille for similar glasses. The relation between density and index of refraction apparently gives a different constant for each constituent oxide of the glass instead of the 0.202 derived by Larsen for glasses, without respect to differences in composition.

Revised Master Specifications for Tableware

The United States master specifications (No. 121) for table glassware, adopted in 1924 (given in full in GLASS INDUSTRY of May, that year) were revised September 25, 1926, by the Federal Specifications Board as recommended by the Bureau. The old specification contained no tolerances for dimensions, capacities or weights of the items listed. Also the capacities of the tumblers was inconsistent with their dimensions.

The tolerances now adopted of plus or minus 3% in dimensions, 4% in capacity, and 6% in weight, and a list of the articles they apply to were given in the September issue of THIS JOURNAL, on page 219.

Paper on the Annealing of Glass

The annealing range varies with the composition of the glass; thus the annealing range for one soda-lime glass is between 480 and 530 deg. C. and for another between 560 and 620 deg. C.; for a lead glass it may be between 440 and 500 deg. C.

For any given glass the annealing range is indicated by changes in its expansion or heat absorption as the temperature is increased. The safe cooling rate is governed by the thickness of the glass and it increases as the temperature decreases. Glass 1 cm. thick can be cooled at about 100 deg. C. per hour (initial rate), the cooling rate for glass 2 cm. thick is 25 deg. C. per hour, and for glass 5 cm. thick it becomes 4 deg. C. per hour.

Tank Control and Devitrification

In the absence of exact data concerning the stability regions and temperatures of crystallizations in the soda-lime-silica systems to which most of the window, plate and bottle glasses belong, an investigation was undertaken to obtain approximate values indirectly, using the petrographic microscope.

By this method the compositions of the crystalline materials produced in soda-lime glasses were determined and were found to be wollastonite (CaO,SiO_2) and $Na_2O.3CaO.6SiO_2$ in window and plate glass and cristobalite (SiO_2) in bottle glass.

The approximate chemical compositions of the glasses were determined, also, and, with these data, the boundary lines between the regions where the crystalline materials occurred as primary phases were drawn. With the results of this study (described by Herbert Insley, of the Bureau of Standards, on pages 1-3 of GLASS INDUSTRY, January, 1926) and knowing the composition of the devitrification crystals, the glass manufacturer may determine in what direction the batch composition is to be changed in order to avoid further trouble.

The Measurement of the Viscosity of Glass

The purpose of this investigation was to determine the temperature viscosity relations of glasses of different composition. This information is of great interest to the glass manufacturer because it is thought that such data will determine the most advantageous temperatures for melting, fining and working glasses.

The apparatus used was a rotary type viscometer. The viscosities of three commercial glasses were determined and tables showing their composition and viscosity are given in the report.

Study of Tank Block

A study of tank block led to the following conclusions:

(1) Corundum and mullite, under the physical conditions existing at the contact of tank block and molten glass and with the concentration obtaining, resist solution better than other possible solid phases and, therefore, refractories made of these materials should show the greatest resistance to glass attack.

(2) The physical structure of the clay block is the predominating factor controlling its life in service irrespective of chemical composition. The block should be homogeneous, the pores should be small and, if possible, closed or non-interconnecting, and this structure should be obtained with a minimum of interstitial glass.

(3) The solution of submerged portions of the block is due primarily to accelerated attack of the glass on the upper surfaces of pores, cracks and laminations rather than to erosion brought about by movements in the main body of the glass.

(4) The use of very high temperatures (1,450 deg. C. and higher) can be expected to materially shorten the life of tank block, due to the decreased viscosity of the glass and the increased solubility of the tank block constituents.

Refractories

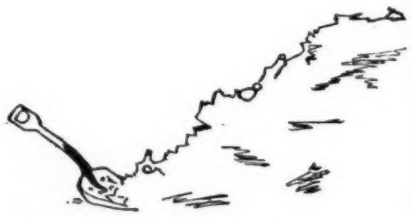
Comparative tests of some American and German fire-clay brick were made. Circular No. 382, "Fire-Clay Brick—Their Manufacture, Properties, Uses, and Specifications," was prepared and issued. Other subjects relating to refractories and heavy clays were investigated.

New Porcelain Protection Tube

The Bureau has developed a double-walled glazed porcelain tube which promises to reduce breakage. The glaze is between the inner and outer tubes. The tube has been described in Technical News Bulletin.

CULLET PILE PHILOSOPHY

By SILICA SAM



The All Work and No Play Executive

Too many executives dupe themselves with the pig logic that justifies semi-monthly week ends, daily golf, bi-monthly conventions and annual ocean trips. It is a fine thing to do these things if one can afford them, but it is deception to encourage them on the plea that they give a "broad view." The businesses that succeed in the long pull are those in which the management has a keen eye for details, for doing the immediate task well. There is an old saying that goods well made are half sold, and this was never truer than right now.

Of course, a lot of businesses do succeed despite the interminable absences of part of the management. But in these organizations is always to be found one or two partners or vice-presidents who are old-fashioned gluttons for work. They're at their desks at eight, eat quick lunches, and stick around until six in the evening. They think of New Year's Day as a dandy time to supervise taking of inventory and they give themselves jobs for Fourth of July and Labor Day.

No one ever hears of these fellows. They belong to no clubs, attend no booster meetings, make no speeches. Now and then they read a printed speech by one of their "broad-minded" fellow officers, and smile quietly. They like to work. They rule the men who work for them with iron discipline, yet they are highly respected by these honest minded, callous handed sons of toil.

There are exceptions to all rules, and perhaps these complex days require loafing executives, but Silica Sam feels like extending felicitations to the man who does the job right in front of him. He may be a bit stupid but as Abe Martin says, "All work and no play makes Jack an invaluable employee."

Foremen's Meetings

Foremen's meetings are also fruitful with many good practical and valuable ideas. Suggestions should be made to or turned in to the executive beforehand and those concerned have opportunity to become prepared for discussion. Some matters should be taken up regularly at these meetings and discussed by the executive such as the latest cost sheets, the budget for the next quarter, customers' complaints, etc. Comments should consist more of encouragement, praise and admonitions than of criticism. When criticism is given it should be only such as applies to the group generally. Criticism of one department or foreman publicly does only harm. He will appreciate the respect shown for his feelings when this is reserved for private conference.

A definite program for foremen's meetings will be found absolutely necessary to carry out their purpose and it is wise to call a meeting only when there is enough on the program to justify it. Foremen should be told a few days before when they will be expected to talk a few minutes on a certain subject and encouraged to look up authoritative material and to endeavor to develop these talks.

It would seem perfectly all right to ask foremen to attend such meetings "on their own time" where a bonus or premium system is in force. Occasionally the foremen should each be told to invite his understudy to "come along." "Esprit de corps" may be found where the cards are face up on the table at foremen's meetings.

False Economy

Look to the storeroom to raw materials, to methods, to labor for false economies. Is your storekeeper ordering all the bolts of a certain size of one length only—long enough for any purpose, threaded all the way, and expecting the men who use them to cut them off when they have need for short ones,—thereby wasting material and labor? Is your purchasing department buying cheap coal that causes expensive glass trouble and doesn't make as much or as good gas?—or cheap, high iron content sand that requires a lot of expensive decolorizer? Is the number of laborers held down in the maintenance gang for economy to the point where they cannot maintain the plant and equipment and it's being "run down"?

Economies may lead to these false economies which bring heavy loss.

Profit

The possibility of a profit is the greatest urge to action ever invented.

No one quite realizes how keen is the chase for a profit until he has been in a competitive business—and every man thinks his business is the most competitive of all.

In a competitive business a profit is the reward for efficiency, for doing the job a little better than the other man can do it.

The business man's profit is infinitesimally small, compared to the benefits conferred on society by his service. Such reward as he receives for his ingenuity is quickly taken away from him by the underbidding of competitors.

It is said that the greatest discovery in the history of the world is the fact that if you tie a bundle of hay three feet in front of a jackass he will keep on walking in a straight line.

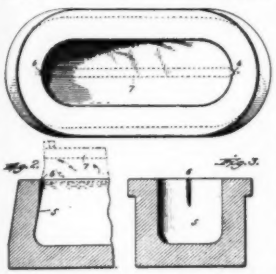
A very profound observation—work out the application!

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

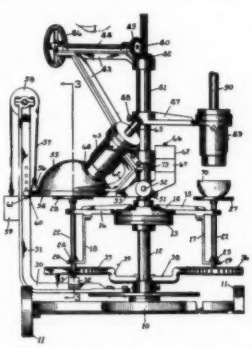
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

GLASS-DRAWING APPARATUS. U. S. 1,597,543. Aug. 24, 1926. George G. Roberts, Washington, D. C., assignor to Virginia Plate Glass Corp. Filed 8/2/23. A glass-drawing crucible having its end-walls undercut to provide an excess of glass at the edges of the sheet which will prevent the sheet narrowing as it forms and ascends, the end-walls each being provided with a central vertical groove to guide the edges of the sheet. The inventor states that the invention may also be applied to the continuous process, the crucible in that instance serving more in the nature of a nozzle than a crucible.



WATER-COOLED-DAMPER CONSTRUCTION. U. S. 1,596,843, Aug. 17, 1926. Edward J. McDonnell, Pittsburgh, Pa., Assignor to Blaw-Knox Co. Filed 9/20/22. Relates to water cooling of open hearth structures, particularly the dampers used in the "McKune" system.

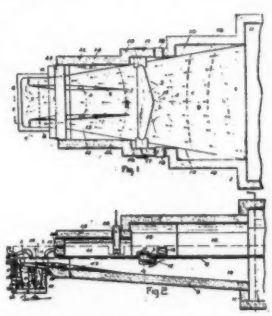
FIRE-POLISHING APPARATUS. U. S. 1,594,557. Aug. 3, 1926. William L. Proeger, Toledo, O., Assignor to the Libbey Glass Manufacturing Company. Filed 4/28/24. The object is to provide apparatus by which the outside of a hollow glass article may be fire-polished uniformly without subjecting any portion of it to excessive heat. A glass article, such as a bowl 70, is placed upon the carrier 27 and the shaft carrier, and while the bowl is rotated by the propeller 36 its inside is subjected to a fire-finishing flame from the downwardly directed burner 49. At the same time another bowl 71, which may have been previously fire-polished on the inside, is in inverted position on the carrier 28. Cooling air is introduced through the nozzle and hollow pipe into the interior of the bowl 71 and may escape through suitable openings 72 in the carrier.



METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS. U. S. 1,593,632. July 27, 1926. John Hartzell, Arnold, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa. Filed 2/16/24. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending lehr tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent the end of the tunnel where the glass enters and permitting the streams to travel through the tunnel in contact with the glass, and abstracting heat from the upper stream in amounts sufficient to substantially equalize the rate of heat loss from the two faces of the glass substantially as described.

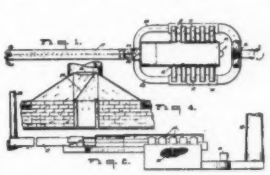
GLASS-BLOWING MACHINE. U. S. 1,597,612. Aug. 24, 1926. Walter Devlin Morrison, Newport, Melbourne, Victoria, Australia. Filed 10/11/21. Means for automatically feeding one or a plurality of pattern and finishing molds arranged radially and in sets around or upon a continually rotating table, which, combined with a superposed intermittently operating rotatable feed table, also provided with a corresponding number of receiving pockets for the molten material, which pockets are radially disposed, and spaced, each set corresponding in number with each set of pattern molds employed, the feeding table being provided with means for delivering the molten glass at predetermined times to the pattern molds by means of receiving cups disposed in a radial casing taking the delivery of predetermined quantities of molten glass from the tank and delivering same by means of a radially swinging cup bracket into the receiving orifices of the pattern molds.

CONTINUOUS TANK FURNACE. U. S. 1,597,440. Aug. 24, 1926. Enoch T. Ferngren, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 3/2/23. A tapering tank construction that is practically devoid of all dead spaces or corners, and wherein all of the molten glass will flow uniformly and evenly toward the sheet source. A peculiarly wedge-shaped float is employed at an intermediate point in the channel to assist in regulating the flow of the upper strata of the glass. An elevated ridge or throttling member is built into the bottom of the channel adjacent the draw-pot, to divert a greater quantity of the glass toward the side edges of the draw-pot.



APPARATUS FOR FEEDING GLASS PARTS. U. S. 1,597,439. Aug. 24, 1926. John T. Fagan and Francis J. Rippl, Cleveland, O. Filed 9/19/22. The combination of an inclined chute having a slot therein adapted to support a series of glass tubes in substantially vertical positions and to allow them to feed therealong by gravity, a holder at the lower end of said chute adapted to receive said tubes and to allow them to be removed one by one in a substantially vertical position and means for preventing crowding during said removal.

MEANS FOR HEATING AN ANNEALING LEHR AND PROCESS OF ANNEALING. U. S. 1,597,481. Aug. 24, 1926. Guy J. Rice, Charleston, W. Va., assignor to the Libbey-Owens Sheet Glass Co. Filed 11/3/24. A tank furnace, means for drawing a sheet of glass, an annealing lehr, and means for heating the annealing lehr comprising a conduit between a portion of the tank furnace and the said lehr for the passage of hot air, means arranged at the inlet to the lehr for controlling the intake therein, and means in the lehr for controlling the heating action of the air.



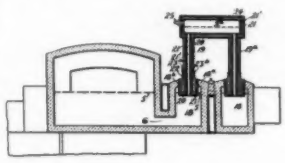
MANUFACTURE OF SHEET AND WIRE GLASS. U. S. 1,597,953. Aug. 31, 1926. Clarence P. Byrnes, Sewickley, Pa. Filed 6/19/20. Drawing a layer portion of glass upwardly from a molten bath, drawing another layer portion upwardly separate from the first layer portion, deflecting one layer portion, prior to uniting it with the other, feeding wire mesh between the glass layers, uniting the layers, and drawing the wire glass in a horizontal direction in a continuous manner.

GLASS FURNACE. U. S. 1,597,073. Aug. 24, 1926. James T. Keenan, Parkersburg, W. Va. Filed 7/7/24. Mechanism for elevating and flowing a quantity of molten glass from the furnace tank to the casting table or blowing machine, pressing machines or the like without the use of dipping ladles or devices similar in character, consisting of a glass melting tank and a communicating refining tank, an auxiliary tank in communication with the refining tank and having a discharge opening above the normal glass level therein a displacer of refractory material, said displacer being hollow and having therein a cooling coil adapted to cool said

displacer, and means to reciprocate said displacer in said auxiliary tank to displace the molten glass above its normal level therein and thereby discharge the same through said discharge outlet.

APPARATUS FOR MELTING AND REFINING GLASS. U. S. 1,598,307. Aug. 31, 1926. Robert D. Pike, San Francisco, Cal., assignor to Cole-French Co. Filed 10/25/26. The inventor claims that if glass be melted in a furnace whose dimension with the flame is over twice as great as its dimension transverse to the flame, or of dimensions, say about 15' x 40', or similar in general construction to furnaces which are used for melting steel, the process of melting alone can be carried out in a much more economical and rapid manner than heretofore, although the glass issuing from a submerged port in one of the longer sides of such a furnace will not be properly fined nor ready for working. But if such glass be immediately taken and passed through some special fining device, more or less independent of the melting furnace proper, which will have a capacity for fining corresponding with the capacity for melting, and be then passed from such fining device into a compartment from whence it may be delivered as required to the working devices, a combination is arrived at for producing properly fined glass at a greater rate per sq. ft. of furnace area and for less fuel per ton of output than is possible by prior practice. A furnace designed to meet the requirements of this process is described.

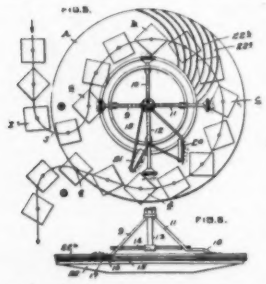
METHOD OF AND APPARATUS FOR FINING GLASS. U. S. 1,598,308. Aug. 31, 1926. Robert D. Pike, San Francisco, Cal., assignor to Cole-French Co. Filed 11/1/22.



In combination with a glass tank furnace, a fining device for glass comprising a vacuum chamber arranged above the level of the glass, producing suction acting upon the glass, a pipe leading from the furnace into one end of said chamber, a working chamber connected with the opposite end of the vacuum chamber, and electrical heating means arranged within said vacuum chamber to maintain the temperature of the glass.

METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS. U. S. 1,597,994. Aug. 31, 1926. William L. Monro, Pittsburgh, Pa., assignor to Window Glass Machine Co. Filed 2/12/24. A method of and apparatus for annealing and cooling sheet glass, including a tunnel, means for passing glass therethrough in one direction, and means for causing gaseous fluid to travel through the tunnel in the other direction in streams on each side of the glass.

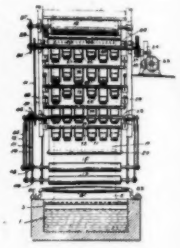
APPARATUS FOR SURFACING SHEET OR PLATES. U. S. 1,598,720. Sept. 7, 1926. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 6/1/22.



An apparatus which requires no setting of glass plates upon supporting tables by the use of plaster, and in which the process of grinding and polishing may be continuous. A series of rubbing beds whose upper faces are provided with suitable grinding and polishing means, in combination with an endless carrier provided with a large number of plate or sheet supporting elements to which the sheets are releasably secured and which carries the sheets over the series of rubbing beds in paths such that a uniform wear is secured upon the surfaces of the tables or beds.

METHOD AND APPARATUS FOR MAKING SHEET GLASS. U. S. 1,599,647. Sept. 14, 1926. Henry F. Clarke, Belle Vernon, Pa., assignor to Window Glass Machine Co. Filed 7/22/24. Apparatus for making sheet glass, including a tunnel through which drawn glass is adapted to travel, a plurality of bars extending along the direction of travel of the glass, and means for imparting to spaced points on the bars similar orbital movements whereby the bars are at times in contact and are moving with the glass and at other times are out of contact and moving in an opposite direction.

APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,598,751. Sept. 7, 1926. Harry G. Slingluff, Mt. Vernon, O., assignor to Pittsburgh Plate Glass Co. Filed 2/26/23.



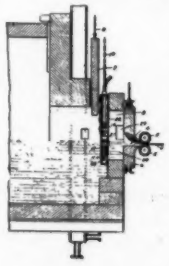
In combination, apparatus for drawing glass in sheet form continuously from a bath of molten glass, comprising a pair of opposing vertical endless driven belts, means for causing the belts to grip the glass sheet being drawn therebetween, a pair of opposing rolls positioned intermediate the bath of glass and the lower ends of said belts, means for causing the rolls to press inward yieldingly against the surfaces of the glass sheet, and means for driving said rolls.

APPARATUS FOR MAKING SHEET GLASS. U. S. 1,598,729. Sept. 7, 1926. Walter G. Koupal and Joseph S. Gregorius, Mt. Vernon, O., assignors to Pittsburgh Plate Glass Co. Filed 1/13/26. Relates to sheet glass drawing tank construction. An improved arrangement of the clay work over the bath, designed to secure a reduction of the temperature at the central portion of the bath as compared with that at the side portions. The glass bath at its central portion normally has a somewhat higher temperature than the side portions. This tends to give a sheet which is hotter at the center and consequently thinner than at the edge portions. This condition also tends to cause the sheet to warp and increases the breakage. To equalize the temperature of the bath, a refractory block is employed extending transversely of the tank on each side of the drawing opening and having its lower edge extending down below said top to a level adjacent the surface of the glass bath in the tank, the said bottom edge of each block being bowed down so that it is closer to the bath at the central portion thereof than at the edges.

PROCESS AND APPARATUS FOR MAKING SHEET GLASS. U. S. 1,598,730. Sept. 7, 1926. Walter G. Koupal, Mt. Vernon, O., assignor to Pittsburgh Plate Glass Co. Filed 8/12/26. In annealing drawn sheet glass by passing it through a vertical casing divided into a series of compartments, it often happens that a crack develops in the sheet extending longitudinally thereof and usually at or near the center line of the sheet.

The inventor has found that this can be avoided by applying heat to the central portion of the sheet just after it enters the casing and at a level where the normal temperature of the glass lies within the critical annealing range, namely between 1050 and 950 degrees Fahr. The preferred type of heating element consists of gas burners in the form of a pair of perforated or slotted pipes located on opposite sides of the sheet closely adjacent the surfaces of the glass and terminating at each end short of the edges of the sheet. The desired result has been satisfactorily achieved in the production of a fifty inch sheet by the use of burners about twenty-six inches long, so that the ends of the burners terminate twelve inches from the edges of the sheet. The heat is best applied by having the burners close to the glass, so that the relatively low flame therefrom impinges upon the glass.

GATE FOR GLASS TANKS. U. S. 1,598,789. Sept. 7, 1926. John E. Sweet, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 1/13/26.

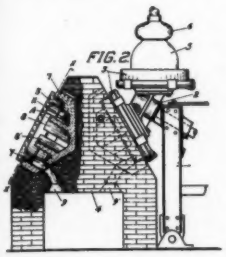


A water cooled gate for shutting off the flow of glass from a glass tank, such as is used for the continuous formation of a ribbon of glass, which permits the application of the heat from the tank to the portion of the tank forward of the gate at the same time that it is applied at the back of the gate, and without withdrawing the gate from its position in the glass, thus permitting of a more gradual application of the heat to the clay slot member forward of the gate and reducing the danger of injury to the slot member due to cracking.

GLASS-WORKING MACHINE. U. S. 1,598,651. Sept. 7, 1926. James S. Moore, Grafton, W. Va. Filed 3/15/21. An air supply system, or arrangement of pipes, air controlled valves, and means for moving the tables of glass working machines and locking them, which system may also include another control valve and accessories to actuate a "kick-out" for the parison receptacles.

TAKEDOWN APPARATUS AND CAPPING HORSE. U. S. 1,598,781, Sept. 7, 1926. Frederick A. Ost, Coffeyville, Kans. Filed 11/15/24. Improved means for conveying a glass cylinder after it has been blown, to the capping horse as gently as possible.

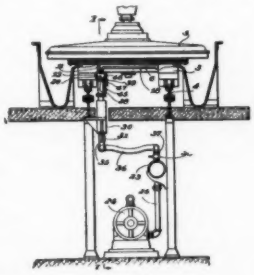
FURNACE FOR HEATING GLASS DRAWING POTS. U. S. 1,598,782. Sept. 7, 1926. Frederick A. Ost, Coffeyville, Kans. Filed 10/15/24.



Relates to improvements in furnaces for heating glass-drawing pots. The primary object is to provide means whereby the fuel gases in a heating furnace may be rotated in a circular motion, thereby producing an even temperature to all parts of the cavity of a pot for drawing glass. In a furnace of the character described a removable combustion-chamber having its closed end cone-shaped, baffles in said combustion-chamber, burners entering the sides of said combustion-chamber for admitting a combustible fuel against said baffles, whereby the burning fuel is given a circular motion.

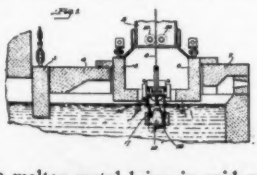
PROCESS AND APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,598,765. Sept. 7, 1926. John H. Fox and Harry F. Hitner, Pittsburgh, Pa., assignors to Pittsburgh Plate Glass Co. Filed 1/13/26. A process of drawing sheet glass, which includes passing a flow of electric current through the layer of glass at the surface of the bath so as to heat such glass above the normal drawing temperature in order to recondition the glass. Clay members extending transversely of the tank on opposite sides of the line of draw of the sheet, each provided with a longitudinal trough or pocket, electrodes in the form of molten metal lying in said troughs in contact with the molten glass, and means for passing a current of electricity between the electrodes and through the surface layer of glass from which the sheet is drawn.

APPARATUS FOR HOLDING PLATES OR SHEETS UPON SURFACING TABLES. U. S. 1,598,766. Sept. 7, 1926. John H. Fox, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 6/10/25. Relates to glass surfacing apparatus, and means for securing the plates or sheets to be surfaced to the cars or tables employed on a straight-away grinding and polishing operation. A practical form of apparatus whereby the necessity of using plaster of paris for securing the plates to the cars or tables is avoided; a suction apparatus for accomplishing the desired result, and the provision of means for insuring constant and effective application of the suction to the glass sheets throughout the surfacing operation.



SHEET-GLASS-DRAWING APPARATUS. U. S. 1,598,073. Aug. 31, 1926. Enoch T. Ferngren, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 10/11/24. In sheet glass apparatus, means for containing a mass of molten glass, means for drawing a sheet therefrom without restraint except at the border portions, and a pair of internally cooled rotatable members at each border portion for tapering off the supply glass at the edge portions to the desired edge thickness.

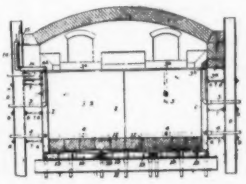
APPARATUS FOR MAKING SHEET GLASS. U. S. 1.598,764. Sept. 7, 1926. John H. Fox and Harry F. Hitner, Pittsburgh, Pa., assignors to Pittsburgh Plate Glass Co. Filed 1/13/26. The combination with a glass drawing tank, of a draw-bar of refractory material extending transversely of the tank submerged below the surface of the glass and provided on its upper side with a longitudinal groove, a molten metal lying in said groove, and means for causing a flow of electric current through said molten metal to heat the glass lying above the draw-bar.



EDGE-HOLDING DEVICE FOR SHEET-GLASS MACHINES. U. S. 1,598,740. Sept. 7, 1926. Leon Mondron, Salem, W. Va., assignor to Pittsburgh Plate Glass Co. Filed 2/16/24. Means for preventing inward movement of the edge of the sheet, comprising a pair of squeezing or thinning pads on opposite sides of the sheet closely adjacent the point of formation thereof where the glass edge is plastic, and means for causing the members to intermittently engage such edge and thin it while maintaining said members against any substantial movement away from the center line of the sheet.

APPARATUS FOR SURFACING GLASS AND THE LIKE. U. S. 1,598,763. Sept. 7, 1926. Albert E. Evans, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 5/3/26. A series of plate glass surfacing machines provided with runners and adjustable counterbalancing devices tending to lift the runners, means for adjusting said counterbalancing devices, means for each machine independent of said devices for lifting the runner entirely free from the glass and for returning it to position in contact with the glass, and a common means for operating all of said means in unison.

GLASS FURNACE. U. S. 1,598,779. Sept. 7, 1926. Charles D. McArthur, Pittsburgh, Pa., assignor to Blaw-Knox Co. Filed 3/11/21. The side and end walls of the furnace, of a plurality of hollow metal sections or units, which more or less closely abut each other at their adjacent edges. Each section is provided with suitable water circulating connections, as indicated at 3 and 4, by means of which water or other cooling fluid may be circulated therethrough. The inner surfaces of these sections are directly exposed to and form the limiting wall for the glass in the tank. In practice, the glass which is in immediate contact with the sections becomes chilled and "freezes" in the joints so as to form effective sealing means therefor.



MOLD FOR GLASSWARE. U. S. 1,600,195. Sept. 14, 1926. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Co., Hartford, Conn. Filed 12/18/25. A mold element for glassware comprising a body portion and an integral funnel portion, and having an annular groove provided therein at the juncture of said body and funnel portions for the circulation of cooling air, and a passageway formed in said funnel portion for the circulation of a cooling fluid.

LIGHT-DIFFUSING GLASSWARE AND METHOD OF MAKING IT. U. S. 1,600,072. Sept. 14, 1926. Franz Skaupy and George Gaidies, Berlin, Germany, assignors to General Electric Co. Filed 3/31/25. The method of making light diffusing hollow glassware which consists in shaping the glassware from clear glass, applying to the glassware a layer of clouded enamel, and superposing upon said clouded layer a layer of different enamel having a smooth surface when fused. One advantage obtained is that the light absorption in the colored layer is kept within very low limits, as there cannot occur repeated reflections in the colored layer.

APPARATUS FOR MAKING SHEET GLASS, U. S. 1,598,770. Sept. 7, 1926. Frederick Gelsharp, Tarentum, Pa., Assignor to Pittsburgh Plate Glass Co. Filed 5/7/23. A feed roll lying across the outlet in the tank wall partly above and partly below the level of the glass in the tank.

GLASS-WORKING MACHINE. U. S. 1.599,182. Sept. 7, 1926. James S. Moore, Grafton, W. Va. Filed 3/15/21. A parison transfer for glass working machines.

MECHANISM FOR TRANSFERRING WARE TO LEHRS. U. S. 1,600,483. Michael J. Owens, Toledo, O., assignor to The Owens Bottle Co., Filed 5/11/23. Mechanism for conveying bottles or other glass articles comprising an endless conveyor, rolls mounted to rotate on horizontal axes and over which said conveyor runs, and holders on said conveyor running around said axes and shaped to receive and hold articles in an upright position on the upper lead of the conveyor with the articles projecting upwardly from the conveyor, said holders arranged to discharge the articles as they run over one of said rolls.

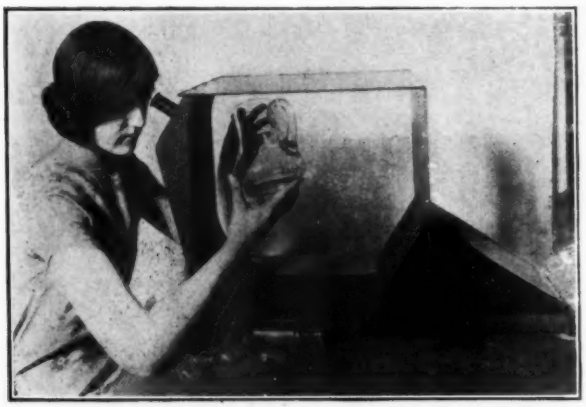
Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

New Polariscope Tests Large Objects

A new polariscope for detecting strains caused by imperfect annealing of glass objects is being manufactured by the Bausch & Lomb Optical Company, Rochester, N. Y., and marketed by the Industrial Apparatus & Instrument Company, Inc., 239 Springfield Avenue, Newark, N. J.

It is an all-metal device and, as will be noticed in the illustration, is so designed that unusually large objects may conveniently be examined. Pieces of glassware up to 15 inches in diameter can be successfully handled.



NEW POLARISCOPE FOR TESTING LARGE ARTICLES

The instrument is designed especially for commercial use in testing mass production ware but can be used for laboratory work.

The optical qualities of the analyzer (eyepiece) are of the standard Bausch & Lomb quality and the design of the instrument is claimed to be such that the color contrasts denoting the strains and their location have a sharper and better definition than heretofore attained in commercial instruments.

No artificial light is required during daylight hours and no special illuminant required after dark in any properly illuminated room. The device is light in weight, requires no accessories, is easily moved about and the inspecting operation is a simple one requiring no technical skill.

Should occasion arise for examining an extraordinarily large article, the metal top can readily be removed and a dark cloth used to exclude the daylight.

Elevating Equipment for Bulk Materials

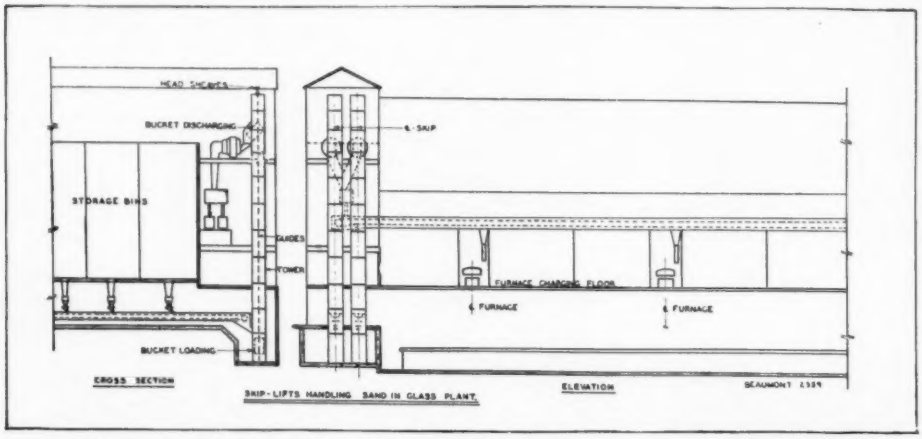
The Beaumont Skip-Lift, a product of R. H. Beaumont Co. of Philadelphia, Pa., is a simple device, for the elevating of granular products, consisting of only a bucket, guides, cable and electrically operated winding machine.

Two distinct applications can be made with this device—one where the elevating is adjacent to a building, the guides being supported by the building wall; the other where the elevating is in isolated locations and the skip-lift is of a self-supporting type. Three methods of operation are possible—full automatic, semi-automatic and manual.

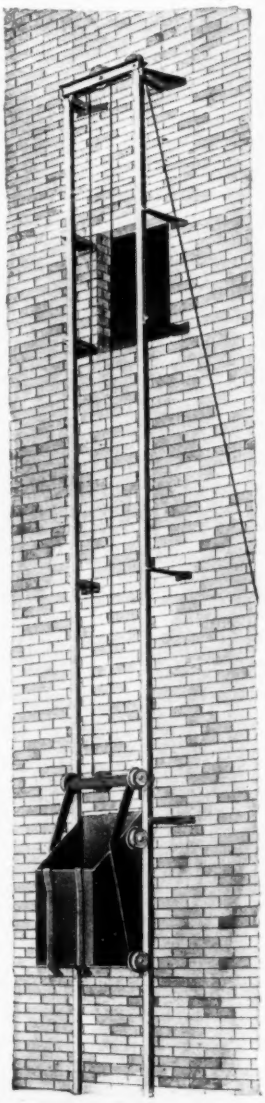
The full automatic type does not require an attendant, except to press a button to start and stop machine. When material is to be elevated, the attendant pushes a button to start the skip. He is then free to go about other duties. When the button is pressed, the bucket descends to the pit where it engages with the patented Simplex loader, receives its load of material and ascends, discharges, descends, reloads and continues this cycle of operation as long as material is to be handled. Pushing a "Stop" button halts the bucket wherever it may be along the path.

The patented Simplex automatic loader, used in connection with the automatic skip-lift, is not dependent on electrical timing devices for operation. It is opened and closed only by contact with the skip bucket. In descending into the pit, the bucket engages with a hook on the loader pulling the loader down into an open position and permitting material to pass into the bucket. Being of the self-damming type, the loader passes full loads of material at each opening, yet prevents flooding and underloading of the bucket. As the bucket ascends, it pushes the loader into an upright and closed position, counterweights on the loader assist in closing and keep it closed.

The second type is semi-automatic. This is the type generally



BATCH MATERIALS ELEVATING AND CONVEYING SYSTEM FOR GLASS FACTORY



BEAUMONT SKIP-LIFT

used for handling ashes and similar service requiring intermittent duty. Here the workman loads the bucket by means of small cars, wheel-barrows, etc., and when the bucket is loaded presses a button to elevate it; the bucket ascends, discharges, descends and comes to rest in the pit ready for another load. The operation of this type of skip-lift is automatic except that it only makes one cycle and stops in the pit after each trip.

The third type is manually operated. One man is required to both load and control the skip-lift of this type. When material in the pit is to be elevated, he loads the bucket by pulling a lever, which opens the unloading gate and permits material in the pit to pass into the bucket. When the bucket is full, he reverses the throw on the lever closing the gate, then by operating a controller, he starts the skip bucket elevating, and, as the bucket reaches the discharge position, he stops it. After material is discharged from the bucket, he reverses the controller, lowering the bucket to the pit and again stops it for reloading.

The loader used with the manually operated skip-lift consists of a vertical undercut slide gate made of steel plate and runs in cast iron guides. It is operated by means of a lever located above the pit in a position where the operator has a clear view of the bucket filling.

The winding machine is the only piece of machinery used in connection with the skip-lift. This is always placed in a position remote from dirt and grit and so located that it is readily accessible for oiling, etc.

The R. H. Beaumont Co. has issued bulletin 79, which describes the features and applications of this equipment.

A New Lehr Loader

An automatic device of novel design for transferring bottles and other glass products from a conveyor to a lehr is the Hemingray lehr loader, developed at the Hemingray Glass Company's plant and recently put on the market by the Simpson Foundry and Engineering Company, Newark, O. The illustration shows an installation of two of these machines at the Hazel-Atlas Glass Company's plant at Zanesville, O.

It is a completely automatic machine, simple in design and of substantial construction. In operation its entire action is governed by three cams. The cycle of the push bar is inward to the lehr on a horizontal plane, as shown in the machine serving the foremost lehr in the accompanying picture, then at the end of the horizontal movement a backing away from the ware, a rise in an angular direction to the position shown at the second lehr, then back on a horizontal plane and down in an angular direction to the starting point.

Two of the principal claims of its builders are that any delay of incoming ware is avoided by having the push bar rise to clear it, and that the pushing action is very gentle.

The loader with a Simpson conveyor as illustrated will handle any kind of ware that will ride on a flat conveyor such as bottles, tumblers, candy jars, etc., up to two-gallon jugs.

Electrifying Power Plant Saves Money

By using electricity, generated on the premises, instead of a number of small reciprocating engines, for driving plant equipment and for lighting, the Whitall Tatum Company, Millville, N. J., shows by a recent analysis a net annual saving of $10,429. This company manufactures a line of druggists' and chemists' glassware.

In 1920 the plant power was supplied by 22 small reciprocating engines and an investigation was made to determine a better method of drive. As a result, a 300-kilowatt turbine generator was installed in 1921, together with motors to handle the factory load. Six months later a second generating unit was installed for the purpose of using one prime mover as a spare, power being needed at all times.

The turbines are four stage, form B machines, each rated 3,600 r.p.m., 80 pounds pressure, and operated condensing. The generators are each rated 375-k-va., 480 volts, 80 per cent power factor. Both prime movers are of General Electric manufacture.

A recent analysis shows that the annual fixed cost of operating the two generating units is $5,785.23, or $15.85 per average day. When the cost of oil, steam, labor, etc., is added, the total cost per 24-hour day is $52.96, or a total cost per generated kilowatt-hour of $.0327.

By comparing the coal consumption with that of the previous installation, a saving of 5.73 tons per day is shown, or $11,294.10 per year. The daily saving in labor charges with the new equipment is $5.37, or $1,960.05 per year.

As against the present fixed cost of the turbine installation ($5,785.23), the old engines had a fixed cost of $2,960.50. Thus the present net fixed cost is $2,824.73. This figure, when subtracted from the total savings of coal and labor, shows a net saving of $10,429.42 per year, or 23% on the investment.

HEMINGRAY LEHR LOADER AND SIMPSON BELT CONVEYOR AT HAZEL-ATLAS GLASS COMPANY'S ZANESVILLE OHIO PLANT

The Glass World and What It Is Doing

News of the Industry

Foreign Firms Join Corning Glass in New Venture

The Blue Ridge Glass Corporation, organized in December of last year and incorporated in New York, is rapidly perfecting plans for entering the market with its sheet glass products, which will include rough and polished wire glass, rough rolled and hammered glass and ornamental and figured glass in all of the principal designs.

The organizers and principal owners of this company are: Société de St. Gobain, Chauny et Cirey, the largest and oldest plate glass manufacturer of Europe; Glaceries Nationales Belges, a Belgian plate-glass company; and Corning Glass Works, internationally known manufacturers of Pyrex products and other special and technical glasses.

The officers of Blue Ridge Glass Corporation with their present affiliations are: Chairman of the board, Lucien Delloye, director general of St. Gobain; president, Alexander D. Falck, president of Corning Glass Works; first vice-president, Eugene Gentil, chief engineer of St. Gobain; second vice-president, Amory Houghton, of Corning Glass Works; secretary, William H. Curtiss, of Corning Glass Works; treasurer, Robert Ingouf, of St. Gobain.

The company has purchased the Kingsport, Tenn., plant of Corning Glass Works, and after making extensive alterations to the furnaces and installing necessary equipment, will commence manufacture there under the general management of Dr. F. F. Shetterly, who was in charge of the Kingsport operations of Corning Glass Works from 1920 to 1922, and more recently has directed the manufacture and development of Pyrex products at Corning, N. Y. Experienced personnel will be brought from France to assist in the introduction of special processes of manufacture. Joseph H. Lewis, formerly a member of the engineering staff of Corning Glass Works, has been appointed plant engineer of the new company. Mr. Lewis is particularly familiar with conditions at Kingsport because he supervised the construction of the plant in 1920. Daniel A. Loupe, who has for several years had charge of credits and collections for Corning Glass Works, will be chief accountant of the Blue Ridge company. Messrs. Shetterly, Ingouf, Lewis and Loupe have already taken up their residence in Kingsport and the work of preparing the plant for active operation is well advanced. Sales plans are now being perfected. The company expects to be prepared to offer its products for delivery generally throughout the United States early next year.

The substantial character and world-wide reputation of the incorporating companies assure the Blue Ridge Glass Corporation of immediate recognition in American markets. Special attention will be given to new methods and processes of manufacture, improved quality and the development of new products in the line of figured and wire glass.

American Ceramic Society at Sesqui-Centennial

The summer meeting of the American Ceramic Society, held at Philadelphia during the week of August 30, brought out a good attendance. Activities began on Monday afternoon, August 30, with a sight-seeing tour of the city, starting from headquarters in the Hotel Bellevue-Stratford. Tuesday was spent largely in a visit to the Sesqui-Centennial Exposition, where numerous exhibits of ceramic products are on view. Some of the foreign glass manufacturers, particularly those of Czechoslovakia and Austria, have large and interesting displays of cut, colored, decorated and other types of glassware.

On Wednesday, the members met in the Educational Building to listen to the following program:

By ALBERT V. BLEININGER: "What are the fundamentals of ceramic materials, mixtures and wares which should be investigated by federal bureaus?"

By P. H. BATES: "Should federal bureaus investigate manufacturing process problems?"

By GEORGE A. BOLE: "Industrial co-operation and fellowships by firms and associations with federal bureaus; to what extent should these be federal financed and what control and rights should co-operating parties have of publication and patents?"

By W. KEITH MCAFEE (read by Herbert Quick): "Benefits of co-ordinated program of ceramic investigations by federal, state and universities."

By Ross C. PURDY: "Proposal of an American Ceramic Research Institute."

By FREDERICK H. RHEAD: "Need of education and research combining substance, form and decoration of ceramic wares."

On Wednesday evening the members had dinner together on the Exposition grounds.

Thursday was devoted to visiting various ceramic plants in the city, and Friday was left open to give the members an opportunity of visiting Atlantic City or carrying out other individual plans.

New Bottle Plant for Los Angeles

The Illinois Pacific Glass Corporation (not "Pacific Glass" nor "Company" as reported in various daily papers) has reached the limit of expansion on its San Francisco, Cal., site, and C. C. Cole, president, advises GLASS INDUSTRY that rather than transfer its entire operations to another location the company has decided to erect an independent unit at Los Angeles, Cal., where many of its important clients are located. In furtherance of that plan, it has acquired extensive acreage at Vernon, one of the industrial suburbs of Los Angeles, and will presently erect a completely modern glass-making unit thereon. This construction is being delayed slightly because the engineering department is fully occupied with the erection of a six-story building which will accommodate the general offices, warehouses, and corrugated box factory of the company immediately adjacent to the existing factory at San Francisco.

Reports which have been published to the effect that the new plant would be financed by the issuing of common stock are said by Mr. Cole to be altogether wrong since no such plan nor any other has been adopted. There are several alternatives from which the company may choose, and while these have been discussed nothing whatever has been determined except that the new plant will be owned and operated by the Illinois Pacific Glass Corporation in close co-operation with the existing plant.

Mr. Cole also states "It is needless to add that the Los Angeles plant will be fully equipped with the electric annealing lehrs that have made necessary the extending of our manufacturing capacity."

Glass Distributors Meetings

The meeting of the western division of the National Glass Distributors Association at Chicago on September 14 was well attended. A number of interesting topics were discussed. A. E. Clerihew of the Forman-Ford Company, Minneapolis, opened the meeting. H. B. Higgins sales manager of the Pittsburgh Plate Glass Company, spoke feelingly of the recent deaths of Weston G. Kimball, Chicago representative, and Harold L. Brown, St. Louis representative. Other speakers were C. E. Ryon of the Western Glass Company, Streator, Ill., R. M. Torrance, Highland Glass Company, and C. J. Gundlach, Mississippi Glass Company. W. J. Schoonover, president of the National association also addressed the meeting and a number of members interested in plate glass discussed conditions in that field, including: H. B. Higgins, Pittsburgh Plate Glass Company; Paul Nesbit, National Plate Glass Company; J. Roy Helm, Edward Ford Plate Glass Company; and R. B. Tucker, Standard Plate Glass Company.

The window glass situation was covered by J. R. Johnston of the Johnston Brokerage Company; W. L. Monro, American Window Glass Company; H. E. Allen, Libbey-Owens Sheet Glass Company, S. Walker, Interstate Window Glass Company, and W. L. Sharp, of Sharp, Partridge & Co., Chicago.

The next meeting of the western division of the association will be held at the Congress Hotel, Chicago, October 26.

Announcement was also made that the National association will hold its next meeting at Pittsburgh, December 7 and 8. An

invitation to be the guests at dinner of the American Window Glass Company was extended by Mr. Monro to all members attending the Pittsburgh meeting.

Members of the Eastern Division of the National Glass Distributors' Association are gathering as this is being written, at Hotel Traymore, Atlantic City, N. J., for the meeting of September 28 to 30. This will undoubtedly prove to be an enjoyable occasion. Secretary Carl F. Doerr recently announced that an interesting program had been prepared for the business meeting and splendid entertainment arranged for.

Organize Shippers' Advisory Board

The Allegheny Shippers' Advisory Board was organized at Pittsburgh, on September 17, to cooperate with similar organizations throughout the country and with the railroads and other interests to improve shipping conditions. One function of the new board will be to make advance estimates of shipping requirements for railroad freight service so that the roads can plan ahead intelligently regarding the movements of freight. D. O. Moore, traffic secretary of the Pittsburgh Chamber of Commerce, was elected general chairman, Joseph Belleville, general traffic manager of the Pittsburgh Plate Glass Company, vice-chairman, and R. E. Cooke, traffic manager of the H. J. Heinz Company, secretary.

The organization committee, composed of representatives of many different industries, include for Ohio: O. C. Jones, Grasselli Chemical Company, and H. G. Huhn, Owens Bottle Company; for Pennsylvania: Charles Carroll, Brighton Fire Brick Company, New Brighton, Pa.; S. S. Woods, Pennsylvania Pulverizing Company, Lewistown, Pa.; George Diack, Queens Run Refractories Company, Lock Haven, Pa.; W. T. Lowe, American Window Glass Company, Pittsburgh; E. George Siedle, Armstrong Cork Company, Pittsburgh; J. H. Wilharm, Diamond Alkali Company, Pittsburgh; Frank M. Ewing, Harbison-Walker Refractories Company, Pittsburgh; William H. Fisher, United States Glass Company, Pittsburgh; and for West Virginia: V. L. Sarbesi, Hazel-Atlas Glass Company, Wheeling, W. V. Also J. C. Magness, traffic director, Glass Container Association, New York.

A. C. S. Equipment and Materials Exhibit at Detroit

A statement has been issued by Ross C. Purdy, general secretary of the American Ceramic Society, calling attention to the fact that during the past four annual meetings the society, in response to what was interpreted as a demand, provided exhibition space for materials, equipment and ceramic products without financial profit. At the next annual meeting to be held in the Book-Cadillac Hotel, Detroit, Mich., during the week of February 14, 1927, the only space available will be in the sample rooms. The local committee in Detroit feels, therefore, that the society should not undertake an exhibit itself but that each of the firms that wish to exhibit their products should make arrangements direct with the hotel in the usual way for the use of sample rooms.

August Building Construction

August construction contracts in the 37 States east of the Rocky Mountains amounted to $600,808,000, according to F. W. Dodge Corporation. This was the second largest monthly total ever recorded for these states, which include about 91 per cent of the total construction volume of the country. Last month's record was nearly 2 per cent under that of August, 1925, the only month that ever exceeded it. The increase over July was 18 per cent. Increases in the Central Western States and in the public works and utilities class of construction were largely responsible for last month's high record.

New Safety Course

An effort to check the rising tide of industrial and public accidents is being made by the New York University with the co-operation of the American Museum of Safety. In response to the demand from all parts of the country for trained leaders in safety work, the University is establishing the first collegiate course in accident prevention. Plans are being made to begin the course early this fall.

The British Institution of Fuel Technologists, with about 150 charter members, has been organized in London with Sir Alfred Mond as president, Sir William B. Peat, treasurer, and Edgar E. Evans, Caxton House (East), Tothill street, London, as secretary. The object of the association is the general advancement of the various branches of fuel technology.

Mrs. Rhea Mansfield Knittle of Ashland, O., is reported to have been commissioned by the Century Company of New York to prepare a historical book on early American glass.

The Owens Bottle Company has provided for the redemption on October 1, of preferred stock of the company to the amount of $322,722 and have requested holders of the stock to turn in shares at $115 and accrued interest. The company has been unable to purchase in the open market enough of the stock to enable them to fulfill the requirements of their by-laws without making a formal call.

The suit instituted by the United States Government in March, 1922, against the American Window Glass Company and fifty-one other defendants charging violation of the Sherman Anti-Trust Act was nolle-prossed in the United States District Court at New York on September 18. The concerns indicted produced a large part of the window glass made in this country and were accused of entering into a conspiracy to fix prices, restrain production and eliminate competition.

Trade Activities

Artistic Lighting Equipment Association is the new name of the organization heretofore known as the National Council of Lighting Manufacturers.

The Twin Falls Mirror & Glass Company has been organized at Twin Falls, Idaho, by D. A. Hamilton and J. F. Kilner.

The Welded Glass Corporation, Newark, N. J., has been incorporated with a capital of $125,000 by Harold Y. Bartholomew, Gustav C. Panserau and A. Vincent Snedeker.

Vitaglass Corporation, which was recently organized for conducting the importation and sale of an English ultra-violet glass in this country, has opened an office at 50 East 42nd street, New York.

The establishment of a new hand glass decorating plant at **Weston, W. Va.,** was recently discussed at a meeting of the Weston Chamber of Commerce. It is expected that the proposed plant will decorate glass manufactured by the Louie Glass Company.

The Sodium Products Corporation has purchased the Western Chemicals, Inc., producers of Thenardite, a natural sodium sulphate which is used in place of salt cake for glass making. The company's office is at 802 Pacific Mutual Building, Los Angeles, Cal.

The Bristol Company, Waterbury, Conn., manufacturers of recording pressure gauges, thermometers, pyrometers, etc., announce the opening of a branch sales and service office in the U. S. National Bank Building, Denver, Col., with H. T. Weeks in charge.

The Belmont Tumbler Company, Bellaire, O., has discontinued manufacturing operations for an indefinite period because, it is reported, of being overstocked. During the draining of the tank the hot glass set fire to some wood work but the fire department soon put it out and comparatively little damage was done.

The Kirk & Blum Manufacturing Company, 2844 Spring Grove avenue, Cincinnati, O., designing engineers and manufacturers of pneumatic ventilating, dust collecting and conveying systems, announce the doubling of their plant facilities through the purchase of an adjoining factory. The new space will be devoted principally to contract manufacturing.

The National Plate Glass Company, Ottawa, Ill., according to reports, has let a contract for an extension to its furnace building, 75 by 100 feet in size, to William Swindell & Sons, Aspinwall, Pa. The contract includes new furnaces to bring the capacity of the melting department up to that of the cast-

ing, grinding and polishing departments, as mentioned in the September issue.

The Central Glass Products Company, a reorganization of the Marion Silver Plating Company, Marion, Ind., has, it is reported, been incorporated with a capital of $25,000. The company, which has taken over the old plant of the Therasse glass plant at Marion, will manufacture glass novelties, including push plates, automobile and bath room mirrors. The officers of the new company are S. E. Barney, president; Roy Barney, vice-president, and Phil Kiley, secretary-treasurer.

The American Window Glass Company is reported to have filed a complaint with the Pennsylvania Public Service Commission against the Pennsylvania Railroad and Pittsburgh and Lake Erie Railroad involving the rates on silica glass sand from the Mapleton, Pa., district to Bellevernon, Jeannette, Monongahela City and New Kensington, Pa. The railroads are accused of charging excessive, unreasonable, unjust and unlawful rates and the commission has been asked to establish a just and reasonable rate.

Eagle Oil & Supply Company, Boston, Mass., have been appointed distributors for Quigley Furnace Specialties Company, Inc., of New York, covering Eastern Massachusetts and Rhode Island, for all Quigley products including Hytempite, acid-proof cement, Quigley refractory gun, and Triple-A protective solutions, etc., which will be carried in stock. W. H. Taylor Company have been appointed distributor for Allentown, Pa., territory. F. S. Murphy, Jr., of San Francisco will cover as service engineer all the West Coast, Texas, Utah, Wyoming, British Columbia and the Orient.

The sale recently noted of the **Northwood Glass Company,** Wheeling, W. Va., to Robert Hazlett for $30,000 has been voided by the United States Court at Wheeling on the ground that the board of tax appeals at Washington has decided that the Northwood Glass Company is liable to the United States government for income and excise taxes amounting to over $2,300—incurred during 1918 and 1919. Another sale will be held at a latter date to dispose of the property under the original terms and taking account of the government claim. Meantime the sale has been voided and the payments made by the purchaser refunded.

The Eastern Glass Company, Rochester, N. Y., recently purchased the idle North Wheeling Glass Bottle Company, Wheeling, W. Va., at a cost of $22,000 and expect to put it into operation very shortly. The plant consists of two large melting tanks, five lehrs and buildings and machinery. The Eastern Glass Company is a large wholesale jobbing corporation and maintains another bottle factory in Olean, N. Y., formerly the Acme Glass Company. They also have large warehouse accommodations in Manhattan and Brooklyn for the local trade there and in addition to these have a force of salesmen covering the entire country.

The Pittsburgh Plate Glass Company has announced the appointment of O. P. Krell, formerly assistant manager of the St. Louis warehouse, to be acting local manager of that branch to fill the vacancy due to the death of Harold L. Brown. The Memphis branch, which was formerly operated under the St. Louis branch, will be operated independently in charge of R. H. Lohmar as manager. L. B. Huguenor has been appointed to take charge of the Chicago territory and warehouse to succeed Weston G. Kimball, deceased, former western manager. The Milwaukee, Davenport, Des Moines, Toledo and Indianapolis warehouses, which were formerly included in Mr. Kimball's territory, will be under the supervision of the general office at Pittsburgh.

New Publications

SOURCES OF FOREIGN CREDIT INFORMATION. A 48-page pamphlet, compiled by A. S. Hillyer, chief, Commercial Intelligence Division and issued by the Department of Commerce through the Bureau of Foreign and Domestic Commerce. The object of the pamphlet is to furnish a ready reference of the principal sources of foreign credit information which exists in the markets of the world and to make known the cost and availability of such data to the American business man, with the thought that a more intelligent and possibly a more extensive granting of foreign credit may be possible to firms justly entitled to credit assistance, as investigation in individual cases may show. The publication contains lists of mercantile agencies, co-operative trade organizations, export journals maintaining credit service departments, banks and service organizations maintaining credit files, trade organizations, etc. in practically all countries. Copies of the pamphlet may be obtained at 10 cents each.

DIRECTORY OF THE GLASS AND CERAMIC INDUSTRIES OF CZECHOSLOVAKIA, published by the Allgemeine Glas-und Keram-Industrie, Haida, Czechoslovakia. First edition, 1926. 4½ by 7 inches. Price $2.00, payable with book order by money order.

Contains on more than 250 pages the addresses of Czechoslovakian glass, china and ceramic works. The lists are printed in German with section headings in German, English and French. A list of the principal classes of products and an explanation of abbreviations, symbols, etc., is also given in the same languages, so that it is possible even for those not familiar with the German language to select the desired names intelligently.

Industrial Publications

Recording Voltmeters. Catalog 1502, Voltmeter section. The Bristol Company, makers of recording instruments, have issued a 24-page catalog devoted to recording electrical instruments, including voltmeters, ammeters, wattmeters, millivoltmeters, frequency meters and shunt ammeters. The company manufactures also indicating and recording pyrometers, temperature controllers and other equipment of interest to the glass trade.

Rockwell Oil and Gas Burners. W. S. Rockwell Company, 50 Church street, New York, furnace engineers and contractors, have issued Bulletin No. 270 which illustrates and describes a number of their oil and gas burners, blast gates and other equipment. The bulletin contains an unbiased technical discussion on the relation of oil burners to the results actually sought in industrial heating operations. Prospective users are strongly advised not to purchase oil and gas burners merely as burners, but to consider them in connection with the heating problem as a whole.

Gear Problems and IXL Speed Reducers. Catalog No. 200. Foote Bros. Gear & Machine Company, Chicago, Ill. This is a catalog that will find a permanent place in the library or on the desk of the men who receive a copy. It is 5 by 7¼ inches in size and contains 621 pages of descriptive matter relating to gearing and speed reducers, including a large number of tables. The book is divided into ten sections and contains an elaborate index and cross-index which makes easy the finding of any desired item. Section 10, devoted to engineering information, occupies 200 pages. This catalog cannot fail to be of decided value to anyone interested in the subjects to which it is devoted.

Lighting Data. The Edison Lamp Works of the General Electric Company, Harrison, N. J., has issued a series of bulletins as follows: "Calculation of the Lighting Installation," which contains a large amount of useful data for calculating illumination problems for stores, commercial and industrial interiors. Information is given to aid in the selection of lighting units best adapted for the class of service and location under consideration. Other bulletins are: "Lighting of Office and Drafting Rooms," "Motor Car, Garage and Display Room Lighting," "Lighting of Metal Working Industries" and "Theory and Characteristics of Mazda Lamps."

Correction

We are advised by Roscoe Atwood, of Corydon, Ind., that the statement made in our September issue in connection with the report of the loss by fire of the plant of the Corydon Glass Company, Inc., at Corydon, to the effect that the company was in the hands of receivers is not correct, and that all of the company's financial obligations were taken care of, a receivership never needed nor even considered. The information on which the statement in the September issue was based came to the GLASS INDUSTRY in the form of a statement over the Corydon Glass Company's name and naturally was considered authoritative.

What Our Advertisers Are Doing

The Louie Glass Company, Weston, W. Va., has just contracted with the Chapman-Stein Furnace Company of Mt. Vernon, O., for two 60 inch by 100 inch standard size, stack type, recuperative day tanks. This is the first installation of this type of tank for this Company. It is expected that the tanks will be in operation within about six weeks.

Morgan Construction Company, Worcester, Mass., announce the receipt of orders during the first eight months of this year for 33 producer-gas machines for installation at the following plants: National Plate Glass Company, 2 machines; Youngstown Sheet & Tube Company, 9 machines; Weirton Steel Company, 10 machines; Bethlehem Steel Company, 6 machines; Sharon Steel Hoop Company, 4 machines; American Steel & Wire Company, 2 machines. With one exception these are all repeat orders, making a total of 650 units placed in service in this country and abroad during the past ten years. Continuous mechanical leveling is the basis of their design.

Personals

A. W. Crownover, until recently manager of the Maryland Glass Corporation, Baltimore, Md., is now connected with the Peerless Glass Company, Long Island City, N. Y. Mr. Crownover is succeeded at the Maryland company by Mr. O'Brien.

William B. Walter has been appointed representative of the Johnston Brokerage Company at Chicago to take the place of Henry A. Cole, who has resigned from the Company's staff.

P. M. Offill has resigned as sales manager of the Simplex Engineering Company, Washington, Pa., which he occupied for several years and has entered the automobile business.

F. M. Beggs, superintendent and **F. L. Bryant,** sales manager of the Tiffin, O., factory of the United States Glass Company recently severed their connections and have assumed similar positions with the Monongah Glass Company, Fairmont, W. Va.

Ralph C. Keil has been appointed superintendent of the Tiffin, O., plant of the United States Glass Company to succeed F. M. Beggs, resigned, according to an announcement made by R. W. Anderson of the Pittsburgh headquarters. Mr. Anderson also announced that the position of sales manager left vacant by the resignation of F. L. Bryant, will be discontinued.

Recent Death

Alfred E. Smith

Alfred E. Smith, a pioneer in the glass decorating industry, died at his home in New Bedford, Mass. on September 6. Mr. Smith was in his ninetieth year. In his earlier days he associated with his brother, Harry A. Smith, in the glass decorating business and they continued for about forty years. Mr. Smith was born at Birmingham, England, where his father had been a glass decorator for many years. In 1850 his father met Deming Jarvis, then prominent in the glass business in Sandwich on Cape Cod, who induced him to come to America. In 1851 he brought his three sons with him, the voyage in a clipper ship taking six weeks. At Sandwich they established what is said to have been the first glass decorating business of the United States. In 1871, the brothers Alfred E. Smith and Harry A. Smith went to New Bedford under contract with William L. Libbey and established a decorating department at the old Mount Washington Glass Works. This was a success from the beginning. A few years later the firm of Smith Brothers was organized and bought out the decorating department. Their products had a world-wide reputation.

Coming Meetings

THE AMERICAN CERAMIC SOCIETY'S annual meeting will be held at the Book-Cadillac Hotel, Detroit, Mich., during the week February 14, 1927.

THE AMERICAN GAS ASSOCIATION will hold its eighth annual convention at the Million Dollar Pier, Atlantic City, October 11 to 15, 1926.

THE AMERICAN BOTTLERS OF CARBONATED BEVERAGES will hold its eighth annual convention and exposition at Buffalo, N. Y., November 8 to 12, 1926.

THE NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace, New York, December 6 to 11, 1926.

THE NATIONAL GLASS DISTRIBUTORS ASSOCIATION will hold its next meeting at Pittsburgh, December 7 and 8, 1926. The next meeting of the western division of the association will be held at the Congress Hotel, Chicago, October 26.

THE AMERICAN MANAGEMENT ASSOCIATION will hold its autumn convention at the Hotel Statler, Cleveland, October 11 to 13, 1926.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, SEPT. 21, 1926.
Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

	Bid	Asked	Last
American Window Glass Machine, com...	61½	63	61½
American Window Glass Machine, pfd....	..	..	82
American Window Glass, pfd.....	..	..	108½
United States Glass.....	15	16	15½
Pittsburgh Plate Glass, com.....	280	..	288
Standard Plate Glass, com.....	..	..	5¾
Standard Plate Glass:			
Preferred cumulative	30	35	32½
Prior preferred	..	..	85¼

TOLEDO STOCK EXCHANGE, SEPTEMBER 23, 1926.

	Bid	Ask	Last
Owens Bottle Machine, com.	114¼	118½	116¾
Libbey-Owens Sheet Glass, com.	142	143½	145
Libbey-Owens Sheet Glass, pfd.	115	116	115

WHEELING STOCK EXCHANGE, SEPTEMBER 22, 1926.

	Bid	Ask	Last
Hazel-Atlas	...	...	49½
Imperial	...	...	72
Fostoria	...	...	150
Central	...	...	75

READERS WANTS AND OFFERS

Situations Open

PACKING ROOM FOREMAN

WANTED: Foreman for packing room making a miscellaneous line of packers' ware. Must be absolutely first class. Give full details of experience and salary expected. All applications held strictly confidential. Address, PACKING, care GLASS INDUSTRY, 50 Church street, New York.

PLATE GLASS FINISHER AND CASTER

WANTED: A man experienced in finishing and casting plate glass, who thoroughly understands the work. State age, experience, wages expected and references. Address, CASTER, care GLASS INDUSTRY, 50 Church street, New York.

Situations Wanted

GLASS CHEMIST

WANTED: Position in plant or laboratory. Extensive training as an analyst with thorough experience on tank operation, lehr management, batch control and pyrometer equipment installation. American, University Graduate. Age 27. Address, GLASS CHEMIST, care GLASS INDUSTRY, 50 Church St., New York.

Current Prices of Glass-Making Materials

September 23, 1926

Quotations furnished by various producers, manufacturers and dealers

		Carlots	Less Carlots
Acid:			
Citric	lb.	.44½	.44½
Hydrochloric (HCl) 20° tanks, per 100 lb.		.95-1.05	..
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	..	.11-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.29½	.29½
Alcohol, denatured	gal.	..	.37½
Aluminum hydrate ($Al(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	..	.05
Ammonium bifluoride (NH_4) FHF	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb.	..	.03½
Antimony, metallic (Sb)	lb.	..	.15
Antimony oxide (Sb_2O_3)	lb.	..	.16½
Antimony sulphide (Sb_2S_3)	lb.	.15	.16½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03½	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	49.00-55.00	51.00-58.00
Natural, powdered, imported	ton	42.00-44.00	45.00-46.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.48
Barium nitrate ($Ba(NO_3)_2$)	lb.	.07½	.07¾
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04¾	.05-.05½
Boric acid (H_3BO_3)	lb.	.09	.09¾
Refined	lb.	.08½-.09	.09-.09½
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.05-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.28	.29-.31
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.28
Black prepared	lb.	..	.30
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	..	.09½-.09½
Artificial or Chemical	lb.	..	.09
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		1.20	1.35
Feldspar—			
100 mesh	ton	11.00-20.00	16.00-22.00
80 mesh	ton	13.50	..
40 mesh	ton	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	40.00
" " 90%	ton	38.00	..
Formaldehyde	lb.	.10¼	.10¾
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02-.03
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.12	.12¼
Litharge (PbO)	lb.	.11½	.11¾
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)	lb.	..	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04½
light (in bbls.)	lb.	.22	.24
extra light (in bbls.)	lb.	..	.32-.37
Magnesium carbonate ($MgCO_3$)	lb.	.06¼	.06¾
Manganese 85% (MnO_2)	lb.	.04¾	.05
Nickel oxide (Ni_2O_3), black—			
for nickel content	lb.	..	.35
Nickel monoxide (NiO), green—			
for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08½
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.06¾
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.07⅝
Potassium nitrate (KNO_3) (gran.)	lb.	.05⅞-.06	.06⅛-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.14½	.15
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.20
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.20	.25
Salt cake, glassmakers (Na_2SO_4)	ton	20.00-22.00	25.00-35.00
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.43
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat per 100 lb.	1.35-1.40	..
Bulk, on contract	Flat per 100 lb.	1.35	..
In barrels	Per 100 lb.	1.69	2.40
In bags	Per 100 lb.	1.45	..
Spot orders .05 per 100 lbs higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¾	.06¾
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	3.60	4.16
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04⅛
95 per cent.	Per 100 lb.	2.40	2.75
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.10-1.30
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.75-4.00
Flowers, in bags	Per 100 lb.	3.10	3.40-3.65
Flour, heavy, in bbls.	Per 100 lb.	2.75	3.05-3.30
Tin chloride ($SnCl_2$)) (crystals)	lb.	..	.45
Tin oxide (SnO_2) in bbls.	lb.	..	.70
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.30-1.90
Zinc oxide (ZnO)	lb.	.07½	.07¾

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to August 24, 1926

		July 1925 Quantity	July 1925 Value	July 1926 Quantity	July 1926 Value	Seven Months Ending July 1925 Quantity	Seven Months Ending July 1925 Value	Seven Months Ending July 1926 Quantity	Seven Months Ending July 1926 Value
Glass and glass products (total)		.....	$702,500	.....	$742,461	.....	$4,951,863	.....	$5,178,080
Plate and window glass—									
Window glass, common, box 50 sq. ft.		1,960	9,589	2,043	13,198	16,385	94,729	19,476	109,601
Plate glass, unsilvered, sq. ft.		101,583	31,153	8,555	6,415	851,036	235,767	695,194	172,562
Other window and plate glass	lbs.	91,288	18,015	169,695	19,277	1,173,298	137,898	1,352,459	134,862
Glass containers (bottles, vials and jars)		.....	243,734	.....	302,745	.....	1,808,086	.....	1,698,542
Table glassware, plain		.....	173,369	.....	139,121	.....	1,013,746	.....	956,998
Table and other glassware, cut or engraved		.....	16,909	.....	12,890	.....	87,371	.....	106,853
Lamp chimneys and lantern globes	lbs.	144,994	29,420	163,733	31,372	1,145,274	202,260	1,332,010	248,281
Globes and shades for lighting fixtures	lbs.	151,766	40,754	130,531	45,545	914,849	274,505	1,009,693	324,711
Chemical glassware	lbs.	18,408	17,284	18,659	17,178	128,583	103,812	127,928	117,717
Electrical glassware, except for lighting	lbs.	221,478	25,308	307,413	28,901	1,902,715	163,149	3,543,264	307,463
Other glassware		.....	96,965	.....	125,819	.....	830,540	.....	1,000,490

IMPORTS

Corrected to August 24, 1926

		July 1925 Quantity	July 1925 Value	July 1926 Quantity	July 1926 Value	Seven Months Ending July 1925 Quantity	Seven Months Ending July 1925 Value	Seven Months Ending July 1926 Quantity	Seven Months Ending July 1926 Value
Glass and glass products (total)		.....	1,570,411	.....	1,689,155	.....	10,156,518	.....	11,934,390
Cylinder, crown and sheet—									
Unpolished	dut. lbs.	3,571,106	178,993	7,291,540	225,475	30,366,660	1,601,166	47,273,294	1,975,450
Bent, ground, beveled, colored, painted, etc., and polished	dut.	.....	43,848	.....	49,196	.....	343,507	.....	348,246
Plate glass	dut. sq. ft.	1,781,102	774,869	2,182,435	701,611	10,704,253	4,898,988	16,040,485	5,294,085
Containers—bottles, vials, etc.	dut.	.....	14,419	.....	19,486	.....	102,604	.....	167,844
Table and kitchen utensils	dut.	.....	12,061	.....	8,765	.....	58,436	.....	45,041
Glassware, cut or decorated	dut.	.....	167,888	.....	240,718	.....	1,107,313	.....	1,427,577
Blown glassware, n.e.s.—									
Bottles, ornaments, etc.	dut.	.....	130,952	.....	201,816	.....	516,142	.....	803,285
Bulbs for electric lamps	dut. No.	1,316,723	15,581	1,305,774	11,402	11,889,966	120,181	11,316,281	127,280
Chimneys, globes, shades, etc.	dut.	.....	83,614	.....	77,086	.....	648,000	.....	601,760
Articles and utensils for chemical, scientific and experimental purposes	dut.	.....	36,510	.....	44,729	.....	176,681	.....	335,991
Other glassware	dut.	.....	111,676	.....	108,871	.....	583,500	.....	807,831